LOOKING TO 2030:

THE WORLD THROUGH THE EYES OF A 19-YEAR-OLD

By Gabrielle Coetzee

ANCHOR | NAVIGATING CHANGE

Gabbi Coetzee, one of SA's smartest young minds, joined Anchor as an intern during her break from studying at the prestigious University of Pennsylvania in the US. We asked her to give us her perspective on the future through the eyes of a 19-year-old. She also interviewed Anchor analysts and fund managers to get their perspectives on the subject.

It is spring in the year 2030. Your bedroom wakes you by opening the e-windows and playing your favourite playlist softly in the background. Your smart lighting is displaying your family vacation photos on the open wall. Your home is entirely integrated. Your greywater from the shower is automatically recycled, and the artificial intelligence (AI) in your closet announces your schedule for the day as you get dressed. Based on the chemical analysis from your smart toilet, your kitchen has prepared a breakfast tailored specifically to your nutritional needs. A driverless car is waiting outside to take you to work.

Clothes are connected to the internet. Meat that was grown and not slaughtered. Advertisements cater towards your biometric data. The 2020s are guaranteed to be a decade filled with technological advancements that humans have never dreamed of before. With all the improvements in AI, renewable energy, and transportation, the world will never look the same.

As a 19-year-old in today's world, there are many things to consider when it comes to safeguarding your financial future. The world is changing rapidly, and the youth of today are eager to invest in technology and take risks with the hopes of possible profits. The youth are more aware of the world's events and trends than ever before.

My name is Gabrielle Coetzee. I am a rising sophomore at the University of Pennsylvania's Huntsman Program, studying Economics and International Studies. During the US summer break of 2021, I interned at Anchor in Johannesburg, South Africa (SA) and built this report. With the combination of my own research and the expertise of the people at Anchor, the following pages will delve into those trends that are predicted to change the world by 2030 and what people, especially the youth, can do about them.

We discuss five major categories: Electric vehicles (EVs), autonomous driving, renewable energy, drone delivery, and genomics. In each section, I will combine some of the latest news and predictions alongside expertise on what these trends mean, how to capitalise on them, and what Anchor itself has done to profit from the future.

The question of when this future will arrive is impossible to answer, but that does not mean that we cannot be a part of, and profit from, our transition into this new world. Opportunity lies in every corner during this decade and this report discusses only a mere handful of possibilities.

May the future arrive sooner than we think!

Gabrielle Coetzee

Our experts

Peter Armitage

Peter is a CA (SA) and started his career in global financial markets in 1994. He has worked as an analyst, head of research and chief investment officer at several of SA's top financial institutions. Peter has been rated the top investment analyst in the annual Financial Mail rankings a record 21 times. He founded the Anchor Group in January 2012.

Henry Biddlecombe

After working in the corporate finance team at Pinnacle Technology Holdings (JSE: PNC), Henry joined the Anchor investment team in 2015 as an equities analyst - contributing to both the local and offshore investment processes. Henry is a CFA charterholder and holds a BCom Investment Management from the University of Johannesburg.

David Gibb

David has managed the Anchor Worldwide Flexible Fund since its inception in May 2013, and the Anchor Global Technology Fund since inception in June 2019. He joined the investment industry in 1994, as an equity analyst at Libam. David has a BSc (Med) degree from UCT and is a CA (SA) and CFA charterholder.

Ross McConnochie

Ross has worked for Robert Cowen Investments since 2011 with a current focus on offshore analysis and portfolio management. Ross holds a B. Bus Sci Finance Honours from the University of Cape Town and is a CFA charterholder.

Seleho Tsatsi

In 2013, Seleho completed his BCom in Economics and Finance at Wits University, where he received the SASFIN Securities Prize. The next year, he was awarded the Postgraduate Merit Award upon enrolment for Honours. He joined Cannon Asset Managers in January 2015 and moved to Anchor in November 2015. Seleho covers the basic materials sector locally and co-manages the Anchor BCI Global Technology fund. He is a CFA charterholder.

Liam Hechter

Prior to joining Anchor at the beginning of 2014, Liam worked at KPMG. Liam studied B.Acc and B.Acc (Hons) at the University of Stellenbosch and is a qualified CA (SA) and a CFA charterholder. Liam is a co-fund manager on the Anchor BCI Equity Fund and is a co-manager on a number of Emerging Market Hedge Fund Mandates, Including the Anchor Accelerator Hedge Fund.

Nick Dennis

Nick has managed the Anchor Global Equity Fund (which won two 2020 Raging Bull Awards) since March 2015. Before joining Anchor, Nick was a Senior Investment Manager in the Emerging Market Equities team at Pictet Asset Management, in London. Nick is a CA (SA) and CFA charterholder. He has a big growth focus and wants to find companies that provide a good and differentiated product or service.

ELECTRIC VEHICLES

Concern for the environment and the impact of climate change has led to a notable increase in demand for EVs. EVs are often presented in modern media as new inventions; however, their technology goes back at least a century to around the time of the first vehicles on the planet.

Around 1900, electric cars made up one-third of all cars manufactured in the US. As power by petroleum became more economically viable and accessible to the public, electric cars faded from around 1920 in favour of internal combustion engines (ICE). In the 1960s, concern over rising petrol prices and air pollution led to the first policies promoting EVs being passed in the US. The breakthrough came from the Toyota Prius, the first mass-produced hybrid car. Many manufacturers joined this new hybrid production, including Tesla and General Motors (GM). By 2014, the world saw 23 plug-in and 36 hybrid car models on the market. These numbers have since increased and are expected to reach new heights in the coming decade.

Figure 1: EVs SWOT analysis
Source: Ark Invest

STRENGTHS
- High and increasing barriers to entry
- Currently in the Growth Stage of the industry life cycle

WEAKNESSES
- High Competition
- High Volatility
- Low Profit vs. ICE manufacturing
- High Capital Requirements

OPPORTUNITIES
- High revenue growth since 2005
- Projected high revenue growth for 2021-2026
- Increase in climate change awareness

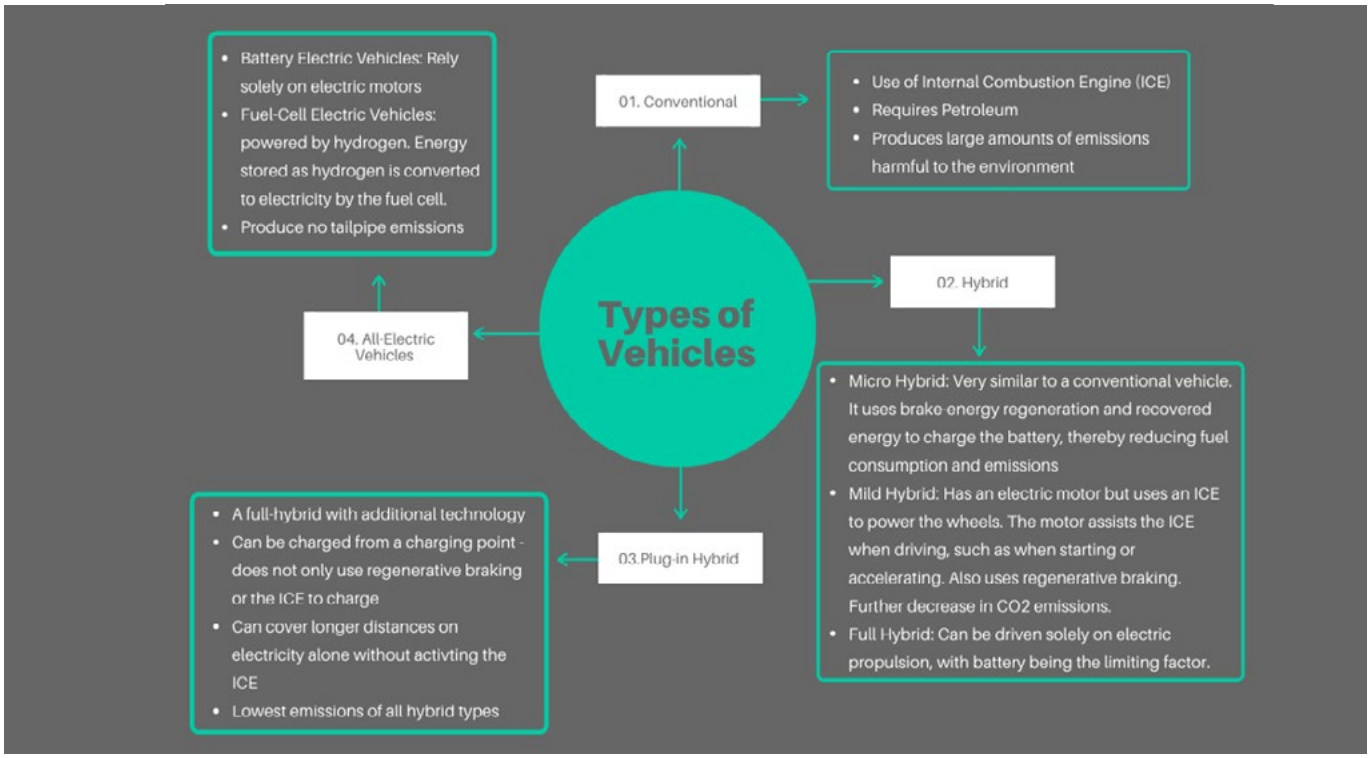
THREATS
- Consumers are less confident in the capabilities of EVs

Global EV sales could scale roughly

20 TIMES

from **2.2 million** in 2020 to **40 million** in 2025

Figure 2: The process - how do EVs work?
Source: Ark Invest

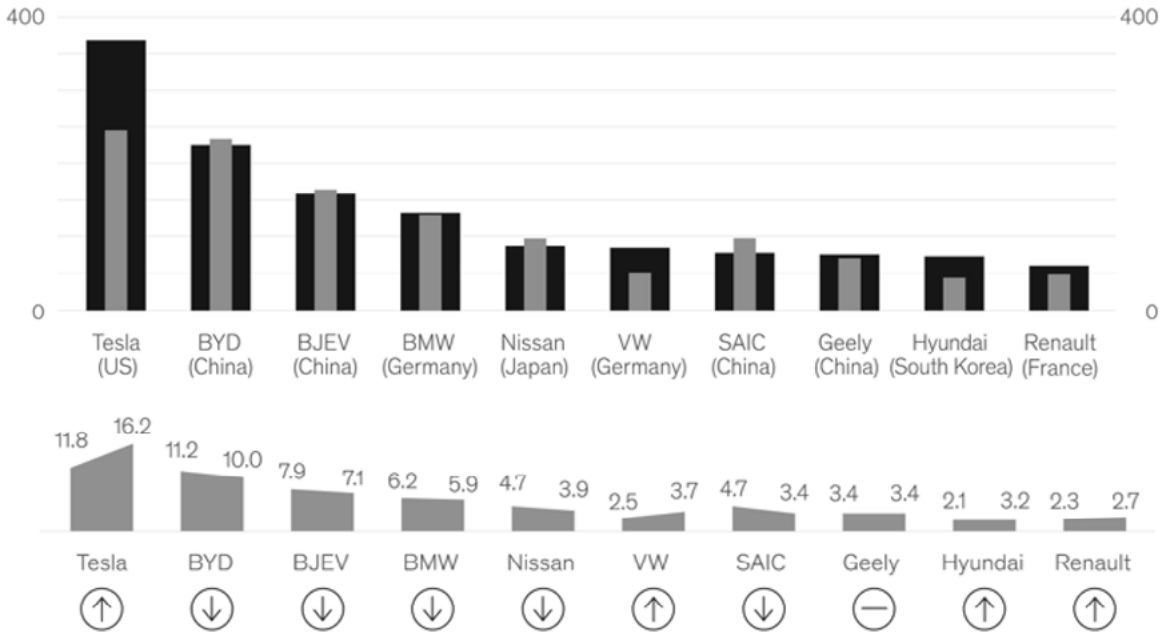


There are two types of EVs: all-electric vehicles (AEVs) and plug-in hybrid electric vehicles (PHEVs). Within the realm of all-electric vehicles are battery electric vehicles (BEVs) and fuel-cell electric vehicles (FCEVs). Both types are charged from the grid and by using regenerative braking – in which electricity is generated using some of the energy normally lost when braking.

AEVs are run entirely with electricity and have an average range of 129km–161km, with luxury models going up to 402km. It can take 30 minutes to charge with fast-charging or up to a day with regular charging - all dependent on the model and the battery used.

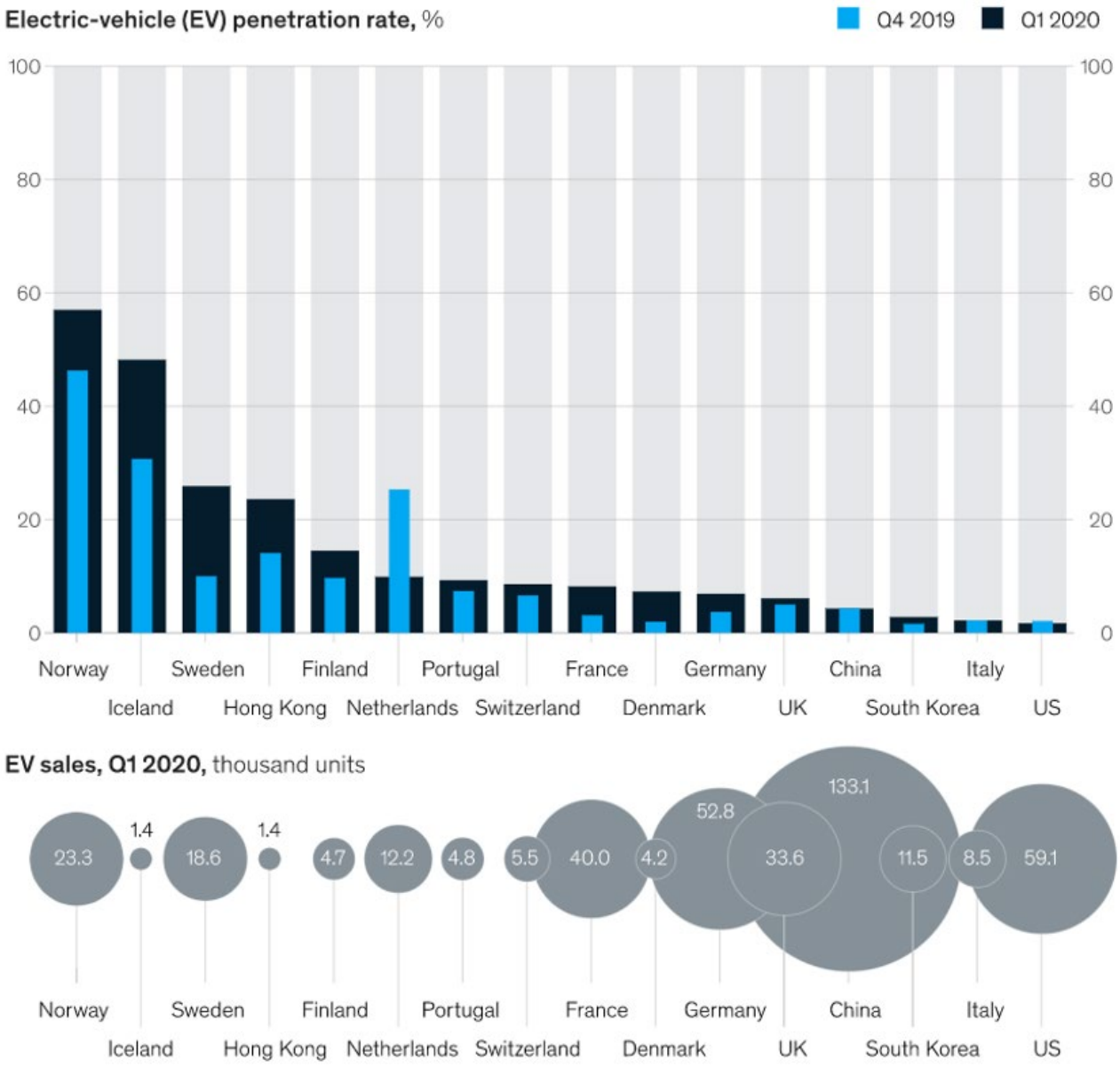
PHEVs use electricity for short distances (10km–64km) and then switch to an ICE that uses gasoline. This provides great flexibility for drivers. In addition, powering the PHEV using electricity from the grid will reduce fuel costs for the consumer, as well as decrease petroleum consumption and tailpipe emissions. PHEVs also use less fuel and produce fewer emissions when using petroleum compared to a conventional ICE vehicle. In addition, PHEVs can use hydrogen in a fuel-cell, biofuels, or other alternatives instead of gasoline.

Figure 3: The current EV market penetration by brand ('000 units) and market share by brand* (%)
Source: McKinsey & Company. *2018 and 2019



Since the launch of the Tesla Model 3, Tesla outperformed many of its bigger competitors prior to the COVID-19 pandemic. Other key players include many manufacturers from China as well as Germany. As seen in Figure 4 below, by 1Q20, nine of the top-10 markets in terms of EV penetration were in Europe.

Figure 4: EV penetration rate and sales by country
Source: McKinsey



A likely contributor to this trend is the European Union's (EU's) new emissions standard – 95 grams of CO2 per km for passenger cars.

- 2021 European emissions target=95 grams of CO2/km target (2020).
- 2025 European emissions target=15% reduction of 2021, 95 grams of CO2/km target (2020).
- 2030 European emissions target=37.5% reduction of 2021, 95 grams of CO2/km target (2020).

Additionally, the China 6 standard, which was introduced on 1 July 2020 for China 6a and will be implemented on 1 July 2023 for China 6b, is one of the most stringent emission standards in the world.

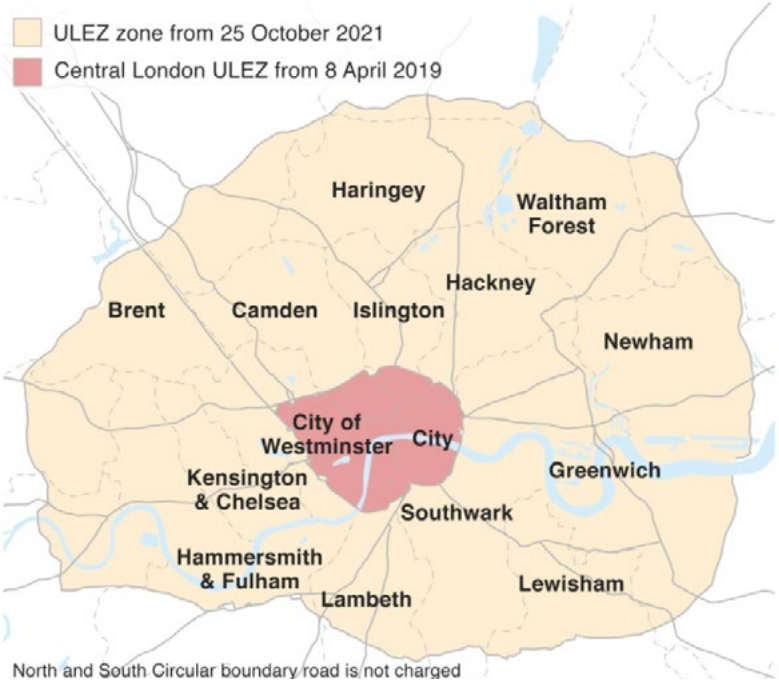
In 2019, automakers launched 143 new EVs and it is predicted that 450 additional models will be released by 2022. Most auto manufacturers have also announced deadlines to become fully electric within the next decade.

The ultra-low emission zone

In reaction to the air pollution crisis, general global warming, and the Volkswagen emissions scandal (also known as Dieselgate or the Emissionsgate, where VW "rigged" diesel-powered vehicles to cheat on government emissions tests), more than 250 cities across Europe have introduced or tightened Low-Emission Zones (LEZ).

Currently, the Ultra Low Emission Zone (ULEZ) in London is one of the most radical anti-pollution schemes in the world. The ULEZ aims to cut pollution in central London by 15% and, more broadly by 4%. According to a British government website, to help improve air quality in the central London area an ULEZ operates 24/7 every day except Christmas Day.

Figure 5: London's ULEZ
Source: TfL, BBC



Most vehicles, including cars and vans, need to meet the ULEZ emissions standards or their drivers must pay a daily charge to drive within the zone:

- GBP12.50 for most vehicle types (up to and including 3.5 tonnes).
- GBP100 for heavier vehicles (over 3.5 tonnes).

But London is not alone – other cities in the world are joining the trend. The leaders of four major global cities - Paris, Mexico City, Madrid, and Athens - say that they will stop the use of all diesel-powered cars and trucks by the middle of the next decade.

Hydrogen cars

One cannot truly consider fully EVs without considering one of its primary alternatives: hydrogen. As mentioned earlier, one can also use fuel-cell EVs or FCEVs.

Hydrogen fuel-cell cars are powered by an electric motor and are therefore classified as e-cars. However, they have one crucial difference to their BEV (battery-electric vehicle) counterparts: hydrogen cars produce electricity themselves. Unlike in fully electric or plug-in hybrid vehicles, these vehicles do not get their power from a built-in battery that can be charged from an external power source. Instead, hydrogen cars have their own power plant on board - the fuel cell.

In the fuel cell, reverse electrolysis takes place: hydrogen reacts with oxygen. The hydrogen comes from a tank built into the FCEV and the oxygen comes from the air. The results of the reaction are electrical energy, heat, and water.

Investment thesis: why invest in EVs?

1. Battery costs are declining, as the scale of EV production increases, and have already fallen 89% from 2010 to 2020 according to ARK Invest. By 2023, average prices will be close to US$100/kWh – the price point at which automakers can make and sell mass-market EVs at a price comparable to vehicles using internal combustion.

2. Consumers are switching to EVs due to environmental concerns as well as increasingly volatile petroleum costs.

3. There are several regulatory instruments promoting the shift to EVs – the EU has the CO2 emissions regulation, China has the new energy vehicles (NEV) mandate, and California has the zero-emission vehicle (ZEV) programme. These are all alongside the UN Sustainable Development Goals and the Paris Agreement.

4. Bloomberg's 2018 Electric Vehicle Outlook report predicts that there will be 289 EV models on the market by 2022, up from 155 at the end of 2017.

5. Bloomberg also forecasts 30mn in EV sales by 2030, up from 1.1mn in 2017, and a predicted 11mn in sales by 2025.

6. EVs are becoming equally, if not more, efficient than ICE vehicles.

Points of concern: what might make investing risky?

1. Will traditional automakers be able to make the shift to EVs, when considering the electrical and software engineering expertise required?

    a. The core business of the traditional automaker originates from ICE cars that are produced with high profit margins. Daimler AG puts the current profit of its EVs at approximately half that of its traditional cars.

    b. Traditional automakers also face a threat from companies like Tesla, which have proven that being a large manufacturer with decades of research is not necessary if you want to build a consumer base.

2. Current barriers in the form of longer charging times and driving distances are subject to radical changes in weather and temperature.

3. The assumption that EVs will account for 50% of new car sales by 2040 is somewhat optimistic. It is not guaranteed that they will dominate the roads.

    a. Consider that the consumer appeal for electric cars is based on their lower carbon emissions and running costs – hybrid cars offer this at a more attractive price point.

4. There is a lot of investment required beyond just the making of the car. You require investment into recharging infrastructure, battery supply chains, and power generation facilities.

What do the Anchor experts say?

Ross McConnochie

In general, I have a similar opinion of investing in technology as that of Amara's law which says: "We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run". I think this is so true in the case of almost all technology and we often see the stock market make this mistake. The market will quickly get excited about new technology, like genomics or blockchain, and hype it up, causing the share prices of the businesses in those industries to explode, only to come crashing down as the market realises that it is going to take a lot longer for these businesses to become profitable than originally thought. Even the Dot.com bubble had the same problem. Everyone knew the internet was the next big thing, but it got completely carried away over the short term.

So, although I am a huge fan of technology and investing in it for the long run, I am still very cautious of the time frames at play when all these predictions are made. That being said, I must admit over the course of the past five years the push for green energy and EVs has increased far quicker than anyone had predicted. So, these things can be brought forward when society demands them.

Nevertheless, I am also a bit cynical about the world's ability to invest in the likes of EVs and green energy as there are meaningful speedbumps ahead in these sectors.

Seleho Tsatsi

We know that after the VW emissions scandal was exposed, a lot of manufacturers were just cheating on government emissions tests. After this was exposed, it looks like even the traditional automakers are being forced to invest in EVs and the timelines seem to be becoming shorter and shorter. Many companies are phasing out ICE, and this trend seems inevitable. It is a small part of annual global sales, but is growing quickly, and regulation is driving the world in that direction.

Tesla is the most obvious example of a potential investment. I am a bit more conservative on valuation – it is trading at a significant valuation already. The company is going for 50% annual growth, which is quite amazing considering it is doing US$50bn-plus in sales. Tesla is also profitable now. The story looks great, but I remain concerned about its valuation. It does look like demand is going to be strong for certain metals due to EVs. Copper, nickel, lithium, and cobalt are predicted to do well. Glencore has a scenario stating that by 2050 copper will go into a huge structural deficit. In ICE vehicles you already use copper, but EVs require more copper per vehicle.

Currently, we do not have exposure to cobalt or lithium, but we do have exposure to copper and nickel. On the JSE it is quite difficult for investors to get exposure to cobalt and lithium, as only Glencore mines them in any size and we do not have exposure to Glencore. Still, the company has done very well this year but there are some corporate governance issues that are of concern to us.

Nick Dennis

Part of the move towards EVs is driven by a more environmentally conscious consumer as well as a push from legislation. One of the things that we are expecting, which has not happened yet, is a US$10,000 EV per car subsidy. This is a meaningful subsidy in this space.

But I think what is happening is that the product is becoming better. If we take the total cost of ownership of an ICE vehicle and an EV, they are almost at parity if they are not there already. In general, because there are fewer moving parts, an EV is less maintenance. With the increase in battery technology, an EV will likely become cheaper than an ICE vehicle. I see this as being inevitable.

There is a sense of range anxiety, but I believe that 95% of cases will be perfectly suited to charge their cars at home. If you are going on a longer trip, companies like Tesla are working on their charging speed as well as their charging network.

In my view, one of the big problems is the supply constraints in terms of cells and batteries, which limit the ability to scale. However, usually supply rises to meet demand and suppliers will make a plan. I agree with ARK's perspective that it will grow exponentially over the next few years, but it will still take time for supply to catch up with demand.

It is important to keep in mind that, even if all manufacturers go fully electric, it will still take 10 to 20 years of annual sale before you replace the existing fleet.

I have held positions in the Chinese EV makers, but I think Tesla will be to the vehicle market what Apple is to the smartphone market. I might revisit the Chinese automakers, but it is hard to hold them when you have researched Tesla.

I think legacy automakers will struggle. China could get a leg up on the rest of the world because it does not have this legacy infrastructure debt that legacy automakers have – they find it very difficult to disrupt themselves. I think production is very complicated, but when it comes to Tesla, it has also designed its own machines. This is where the legacy players will struggle.

Henry Biddlecombe

All of the big car manufacturers are bringing forward the deadline to go completely electric. None of them are spending any research and development (R&D) money on developing new fossil fuel engines and, instead, all their incremental research is going into electric drive trains. Manufacturers such as Volvo and Mercedes have announced fully electric deadlines for the upcoming decade. Ten years ago, those types of deadlines were unthinkable, so the trend is accelerating.

Governments are definitely pushing this trend, as seen by the London ULEZ, where you pay a daily charge to bring your vehicle into Greater London, if you drive a fuel-powered car. That zone itself has increased in size since its creation. If your repayments on a vehicle are, for example, GBP500/month, you would rather sell your old car and go all-electric. You have a push and pull that is driving this change. You would want to look downstream to invest. You do not necessarily want to invest in Tesla or BMW but maybe the companies that made the systems that are incorporated into EVs. One company I like is Aptive – it produces the visual sensor system that autonomous vehicles (AVs) use to drive. It also produces the 48-volt system which runs the vehicle. You may also want to consider battery technology companies and lithium producers.

Platinum comes into it as well. ICE vehicles use catalytic converters and a big component of that is platinum. With the world shifting towards EVs that might be a sunset industry. However, Anglo American is researching the use of platinum in lithium batteries and its early research is indicating that platinum can make it more efficient. That would extend the lifespan of that industry.

Peter Armitage

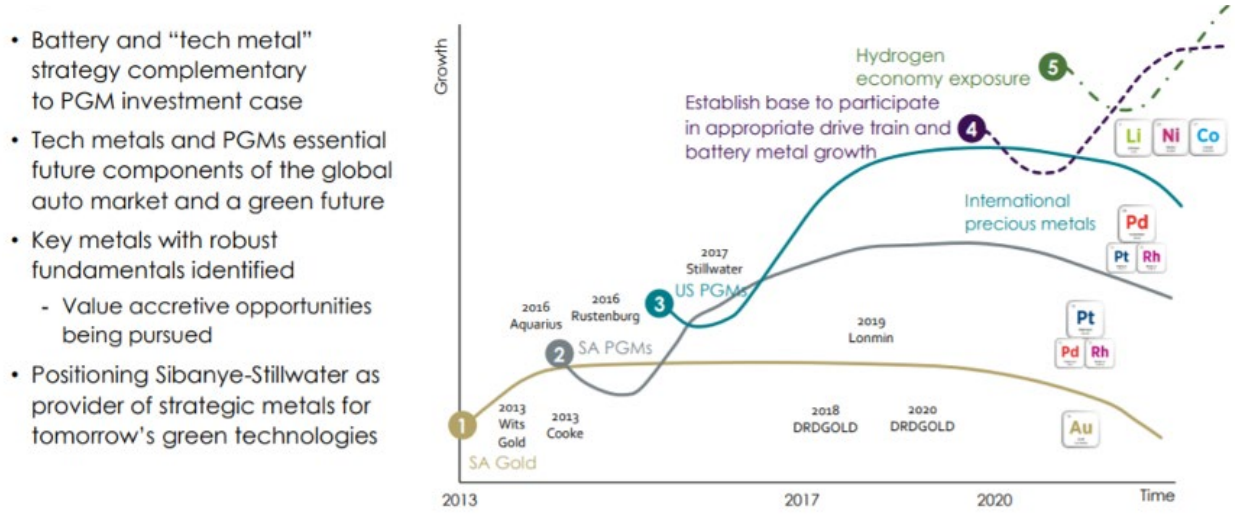
This definitely has an impact on oil as well. In terms of investing, it is not only about investing in the things that grow but also about avoiding those things that will decline. With the rise in EVs, the use of oil in petrol will fall.

There is also the impact on metals. Sibanye-Stillwater is a story of governments around the world collectively increasing vehicle emission standards, which has resulted in a surge in the demand for platinum group metals (PGMs), with supply constrained because of a lack of investment. This is due to an industry in financial distress after the 2008 global financial crisis (GFC) and an uncertain and unsupportive investment environment in SA, which accounts for the bulk of global PGM production. PGM prices have risen to levels nobody would have dreamed of a few years back.

Figure 6 below (from a Sibanye presentation), gives a hint of the future. The next 3-5 years seem predictable in terms of supply and demand, but further out there is a lot more uncertainty. PGMs play little or no role in EVs and the pace at which these are replacing ICE vehicles is a key metric for the company.

But as the company points out, EV is not all about batteries. EVs will play a major role, however bigger vehicles like trucks, buses, ships etc. cannot use batteries and that is where PGMs come in. They will be used in electrolysers (which convert water to hydrogen) and then that hydrogen will be used in fuel cells (using platinum) to create energy. The fuel cells use much more platinum than autocatalysts, so alongside continued (but declining) sales of ICE vehicles, demand will remain.

Figure 6: Positioning for tomorrow's green technologies
Source: Sibanye Stillwater



Liam Hechter

There is no doubt, as someone sitting in London, that over the next 5 to 10 years we are not going to be driving petrol cars. In London, the tax incentives are so advantageous that it is impossible to buy an ICE vehicle. The small passenger vehicle cars will definitely move towards electric, because of the climate issue and regulation. It is irreversible and will dominate society very soon.

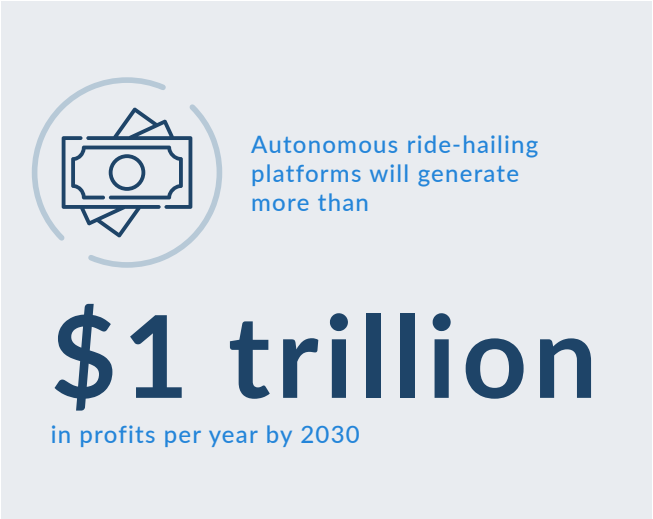
There is a business case and an investment case. The business case is that we are all going to drive EVs in Europe in the next 5 years. Marrying this to an investment case is where the nuance comes in. Tesla is the pioneer and has outperformed expectations, but I can go online and look at 6 or 7 exceptional options for EVs, and Tesla for me is probably not even in those top 5. You must also look at VW and BMW as well as other players. Should Tesla be trading at quadruple the value of BMW if all car manufacturers are going to be producing EVs in 5 years?

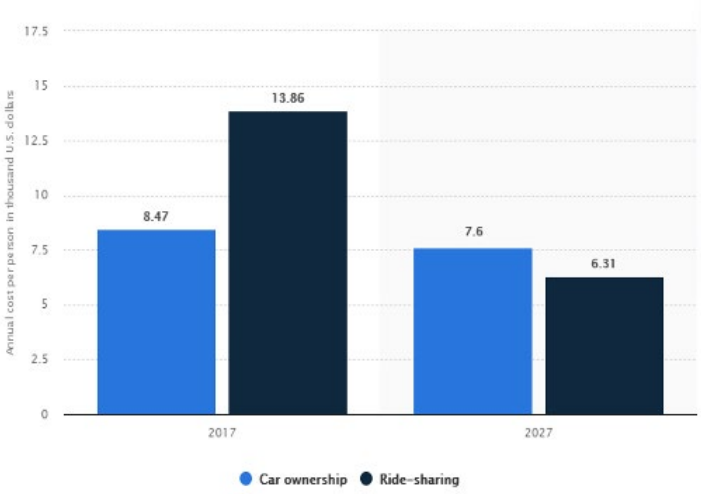
AUTONOMOUS VEHICLES

AVs have taken over the imaginations of the world's largest innovators. With Google's 2009 announcement that it will start its research into self-driving, the concept became wildly popular amongst start-ups and legacy auto-manufacturers alike. Tesla most notably started to commercialise its autopilot feature in 2015, but other companies such as Ford and Mercedes have dived into the mix and are racing to dominate AVs.

The possibilities of AVs are endless, especially regarding mobility and cost-effectiveness. In its 2021 Big Ideas report, ARK Invest states that it believes autonomous ride-hailing will reduce the cost of mobility to one-tenth the average cost of a taxi – making it cheaper, and possibly even safer. Forbes described a report by the *Insurance Institute for Highway Safety* that self-driving cars could eliminate at least one-third of accidents, simply by not having human errors of perception and not being susceptible to substance abuse.

Figure 7: Estimated annual cost of ride-sharing vs car ownership in 2017 and 2027 (in US$1,000)
Source: Ark Invest, Statista





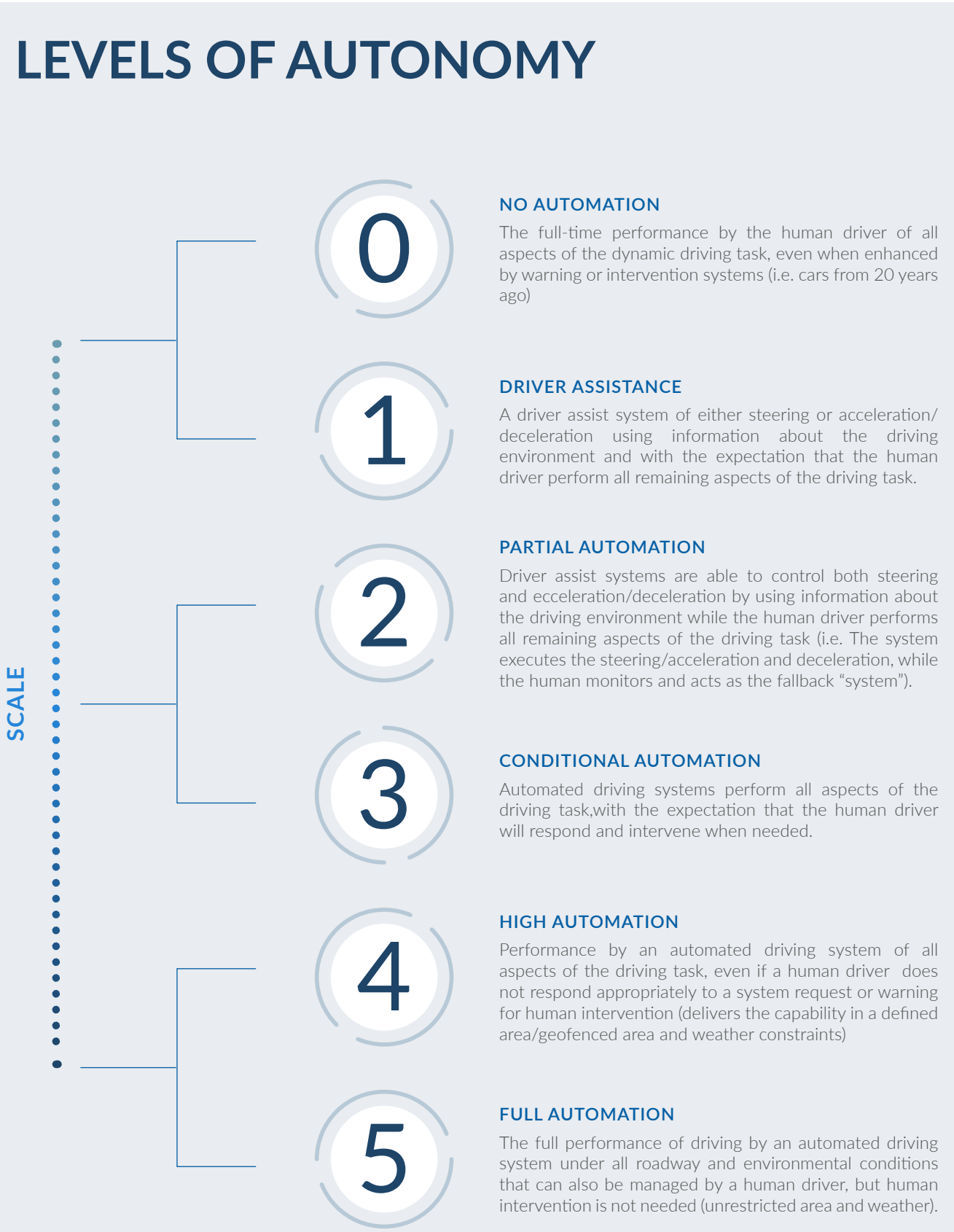
The difference between a ride-hailing and ride-sharing service today is minuscule. Ride-hailing refers to the process of hailing/hiring a driver to reach the exact location where you wish to go. In this case, the vehicle is not shared by anyone else, and it does not make stops along the route. Ride-sharing is similar to carpooling – people going in the same direction can share a vehicle. When it comes to AVs, there is a big opportunity to create a network of AVs that operate as ride-sharing or ride-hailing vehicles – thus replacing companies such as Uber and Lyft.

As seen above, *Statista* has predicted a dramatic decrease in the cost of owning and ride-sharing AVs from 2017 to 2027. As *Figure 7* indicates, at estimated annual costs of US$6,300, ride-hailing could become cheaper than car ownership by 2027.

Regulations for autonomous vehicles

When it comes to autonomy there are six distinct levels as described by engineering group SAE international. At level 0, you have no autonomous features. Level 1 includes lane-centering or cruise control. Level 2 includes lane-centering and cruise control at the same time. At level 3 and up you are not driving once the autonomous features are engaged, although at level 3 you must drive when the feature requests that you do so. Level 3 might include a traffic jam chauffeur-type feature, although level 3 and level 4 indicate that the car can only drive in certain conditions and will not operate unless those conditions are met. At level 4 the pedals or a steering wheel might not even be installed. The highest level, level 5, means that the vehicle can drive in all conditions.

Figure 8: Levels of autonomy in cars
Source: Statista



In SA, the Department of Transport, in its strategic performance plan for 2021/2022, said that it plans to introduce new regulations for AVs. This follows an increase in regulations around the world.

Germany was one of the first countries to introduce regulations. The federal government launched an ethics commission to look at the ethical and legal situation of autonomous driving. In June 2017, it approved a report consisting of 20 ethical rules, including the fact that protecting humans always takes priority.

By 7 April 2020, 29 states in the US as well as the District of Columbia had enacted some form of AV legislation. *The US Department of Transportation's (DOT)* policies have established six automation principles that will be utilised in its role in overseeing AV development:

1. prioritising safety;
2. remaining technology neutral;
3. modernising regulations;
4. encouraging consistent federal and state regulatory environments;
5. providing guidance, research, and best practices to government and industry partners; and
6. protecting consumers' ability to choose conventional and AVs

Most intriguing are the legislative developments in China. Amongst these developments is the 10 February 2020 release by China's National Development and Reform Commission, alongside ten other government agencies, of the *Strategies for Innovation and Development of Intelligent Vehicles* (known as the "Strategies").

In this release, a two-step plan was presented for AV development in China:

1. By 2025, China proposes to create a systematic framework for infrastructure, technological innovation, regulations, and standards, industrial ecology, product regulation, and network security in the AV market
2. From 2035 to 2050, China means to fully establish an ecosystem for AVs.

The current AV market

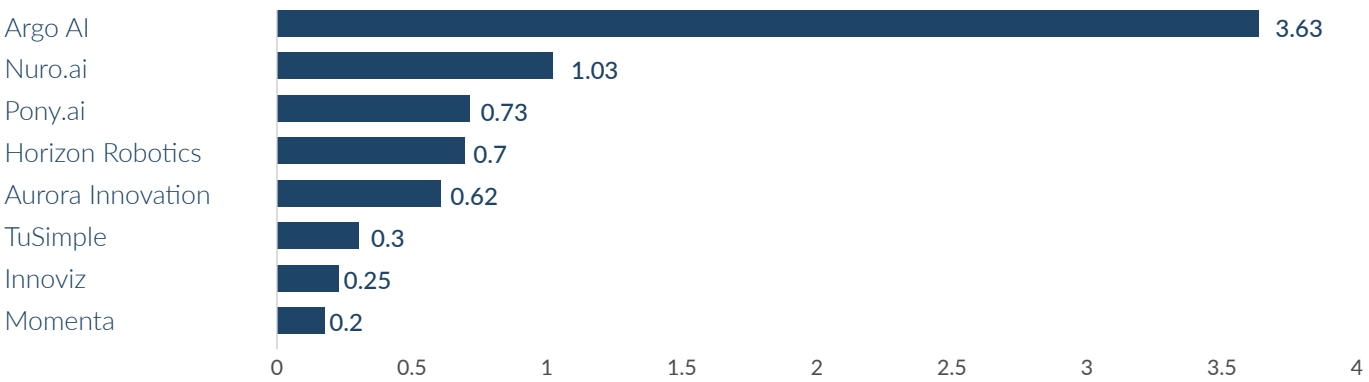
When looking only at the largest patent owners, we had clear leaders in the form of Toyota, Ford, and GM by the end of 2019. However, there are many start-ups in this industry, and larger players like Tesla, which has already launched some autonomous features in its vehicles.

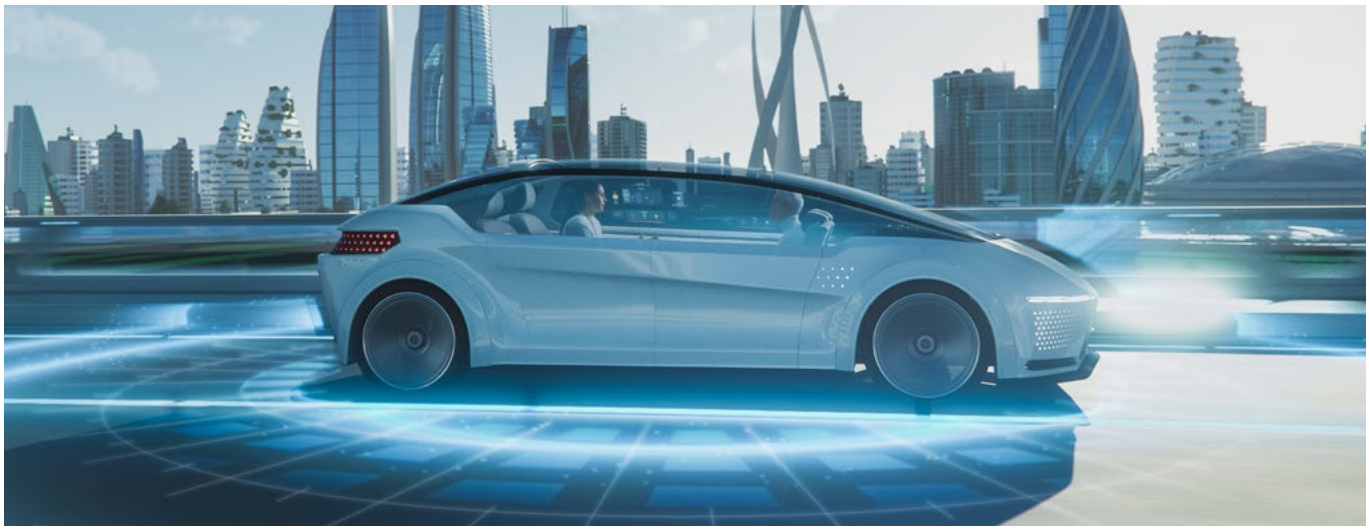
As of 6 May 2020, US AV company, Argo AI was the most well-funded start-up. The company, at the time of this statistic, received c. US$3.63bn in funding. It built the software, hardware, maps, and cloud-support infrastructure that power self-driving vehicles.

However, the opportunity is not just centred around AVs, but its potential for ride-hailing. Essentially, it is looking at the introduction of robotaxis.

ARK Invest, writing in its *Big Ideas 2021* report, says that the ride-hailing market today generates roughly US$150bn in revenue globally, with profit margins as high as 50% in high-performing cities. Autonomous ride-hailing could similarly generate 50% margins, but its lower cost should expand the total market from US$150bn in revenue to US$6trn-US$7trn by 2030.

Figure 9: Key startups in the field of AVs worldwide as of 6 May 2020 by funding, US$bn
Source: Tracker Technologies





Three strategies currently in the market:

As described in *Ark's* report, there are currently three strategies in AV development making headway:

Tesla

Tesla's approach is camera-based, but it also includes ultrasonic sensors and radar. With less accurate sensors than LiDAR, it makes the path to Level 5 autonomy much more challenging. However, cameras do not rely on HD maps and should enable a much more scaleable service. Tesla could be the first autonomous taxi network to scale nationally, because it is cheaper to scale and due to its access to data. The company is reaching autonomy by using customer-owned cars to collect data. It has hundreds of thousands of cars on the road, many of which use Tesla's Autopilot system every day, and Tesla, according to its privacy policy, collects information about how well the feature performs.

Alphabet's Waymo

Alphabet's Waymo is using LiDAR and HD mapping. Waymo launched its autonomous network in Arizona, and it also operates in Texas, California, Michigan, and Georgia. It will need time, and significant resources, to scale nationally. LiDAR is similar to radar but sends out millions of laser light signals instead of radio waves. It then measures how long it takes for them to bounce back. This makes it possible to generate a high-resolution picture of the car's surroundings. It maintains this precision even in the dark - cameras are worse in the dark, and radar and ultrasound are not as precise. LiDAR can be expensive and bulky – which is where Waymo loses its scalability factor. Waymo also has access to huge amounts of data, however, most of it comes from simulated driving.

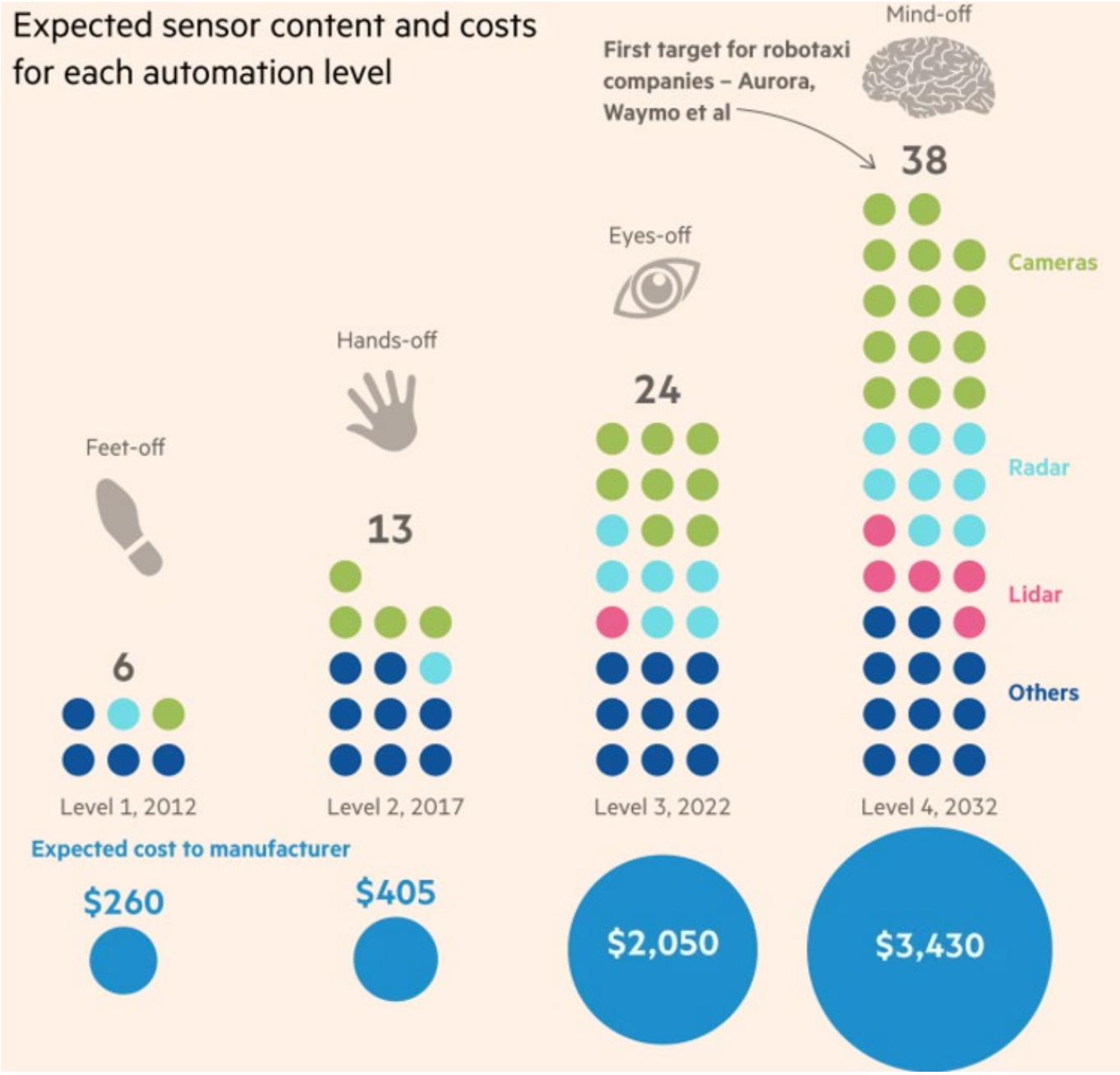
China

Chinese players, such as Baidu's Apollo, are building out infrastructure sensors to help vehicles recognise road signs and traffic. Requiring large infrastructure investments, this approach to autonomous ride-hailing appears to be the least scaleable of the three.

There is, however, an alternate view that going fully autonomous is not as scaleable as people might think. Companies like Waymo and Cruise have had major success in developing this technology, but self-driving cars have not expanded to multiple cities in the world – costs are exorbitant, and testing hours are long and strenuous.

As described by the Financial Times (FT), there is another approach - advanced driver-assistance systems (ADAS). This is more of a bottom-up approach to developing AVs. The problem with groups like Waymo, Cruise, and Aurora is that it is either all or nothing - full autonomy, or no product. ADAS is a more step-by-step path. Instead of reaching for Level 4 or 5 directly, they build up from Level 2 (as with Tesla's Autopilot). This approach is much cheaper and, while those companies trying to provide Level 4 are trying to decrease costs, the ADAS approach is gaining significant speed.

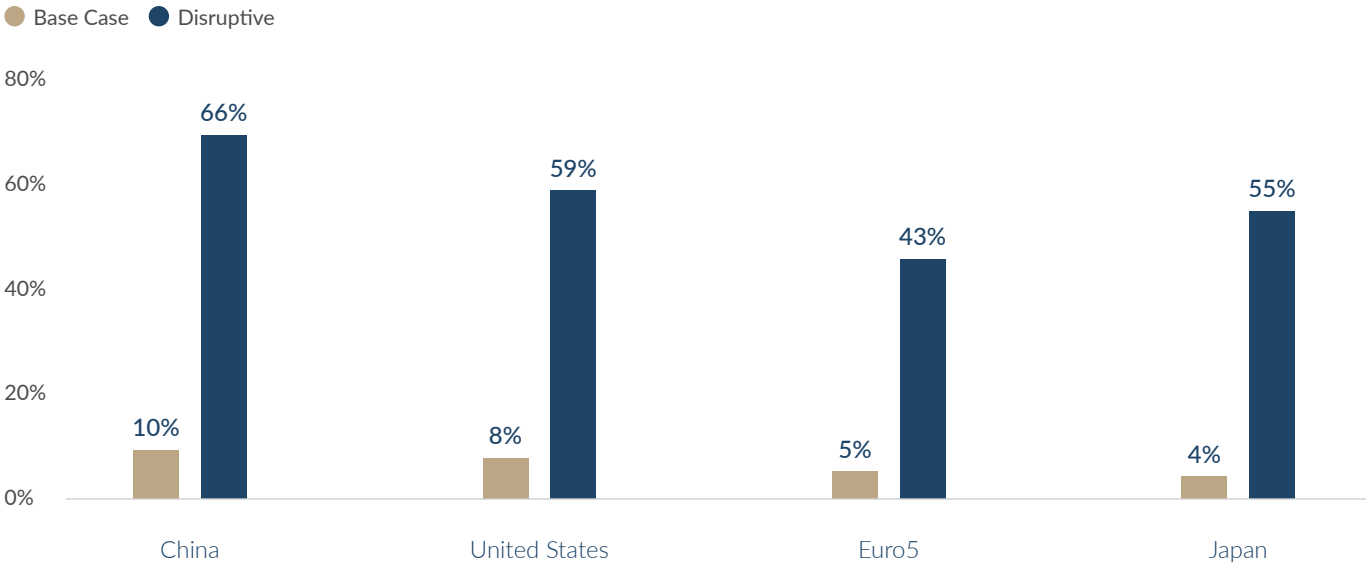
Figure 10: Expected sensor content and the cost for each automation level
Source: Xilinx, yole Development, FT



Investment thesis: why invest in AVs?

1. US Lawmakers are pushing for the US to manufacture more AVs as part of its trade battle with China. These lawmakers want the National Highway Traffic Safety Administration to exempt 15,000 AVs per manufacturer from current human-driving safety standards. At present, an automaker can produce 2,500 of these vehicles for testing only.
2. While there was an estimated total of c. 31.4mn autonomous cars (with at least Level-1 autonomy) globally in 2019, this number is expected to increase to 54.2mn by 2024.
3. In a base-case scenario developed by Statista, around 10% of all vehicles sold in China in 2035 should be at Level 4 or Level autonomy. In a disruptive scenario, the share of AV sales should amount to 66%.

Figure 11: Level 4/5 AVs as a share of total vehicle sales in selected regions in 2035, by scenario
Source: Statista



4. In 2021, the market is forecast to recover from the drop due to the pandemic and to start growing again, reaching a size of US$37bn in 2023.

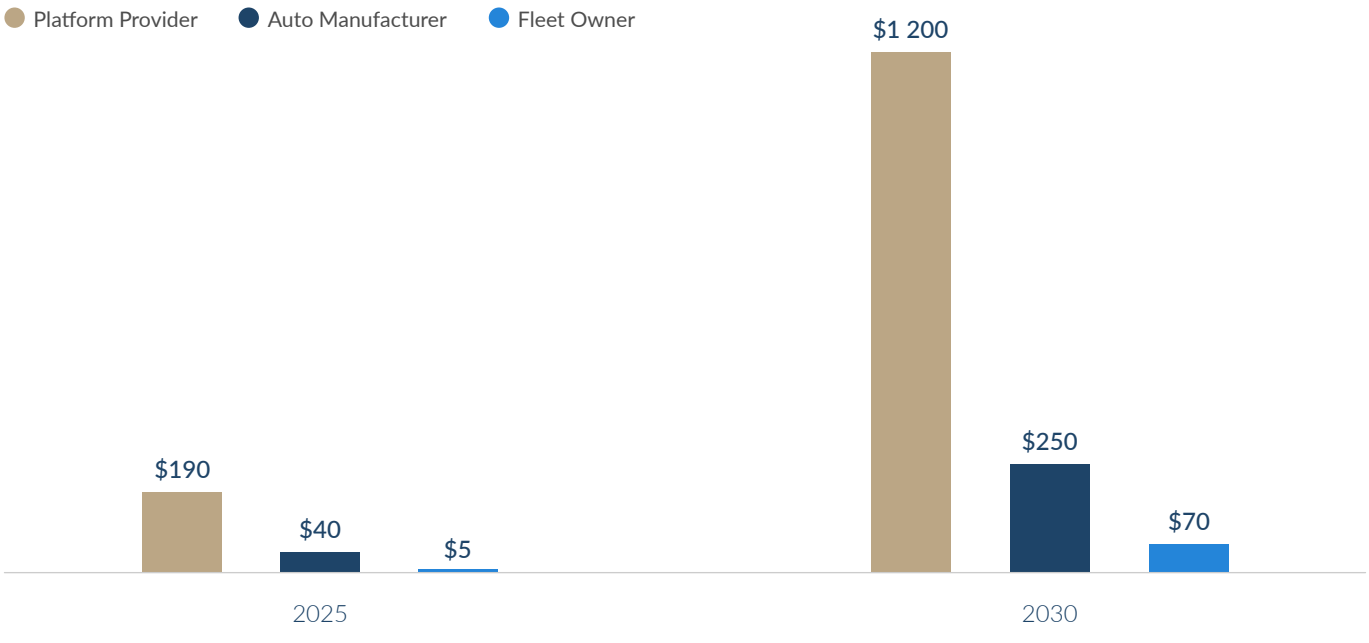
5. ARK Invest, in its Big Ideas 2021 report, says it believes autonomous ride-hailing will undercut the cost of human-driven, ride-hailing by c. 90% in the US and 50% in China.

6. The same report indicates that autonomous ride-hailing could generate 50% margins, but its lower cost should expand the total market from US$150bn in revenue to US$6trn-US$7trn by 2030.

7. Auto manufacturers with EV platforms, partnered with autonomous technology providers, could generate c. US$250bn in earnings annually by 2030.

8. Fleet owners that own, house, and maintain autonomous ride-hailing vehicles could generate c. US$70bn in earnings annually by 2030.

Figure 12: Estimated operating earnings across the autonomous value chain, US$bn
Source: airbq.com



Points of concern: what might make investing risky?

1. AV manufacturers are responsible for liability risk in the form of damage to people or property, especially while the technology is still being developed.

2. A fully autonomous car needs to be able to collect data on objects, distance, and speed in all environments and conditions. Anything from bad weather and heavy traffic to road signs being partially covered by graffiti or nature can impact these accuracies. This has been shown in Uber's accident, where an Arizona pedestrian was killed during an AV test, and in Tesla's numerous incidents and crashes with its Level 2 autopilot.
3. Autonomous driving will require machine learning and AI to fully operate. Currently, there is no widely accepted basis for ensuring these algorithms are safe.

4. Current regulations assume that a human driver is present to take over in case of an emergency – there is a lack of regulation regarding Level 5 autonomy.

5. Cybersecurity will become an even bigger problem. The risk of hacking will influence the safety of these cars.

What do Anchor's experts say?

David Gibb

Unlike EVs, we have not seen the return on the autonomous front yet. The rise in this technology has also been delayed somewhat with the accident in Uber's programme and other events. This has resulted in autonomous driving technology taking a bit longer to become easily available. As humans, we set a very high bar for autonomy in the name of safety.

There are two different approaches to autonomous - going autonomous in parts like Tesla or going fully autonomous like Waymo. On the fully autonomous front, the biggest players would be Waymo from Alphabet and Cruise from GM. To get exposure to Cruise you would have to buy GM since it has operational control. The market seems to be settling down a bit although many players that were previously involved, such as Uber and Lyft, have retracted due to the amount of capital needed.

There are, however, other players that are trying to tackle autonomous driving from the truck market. This includes Aurora. There is also Zoox, which was purchased by Amazon to possibly take over the company's delivery vehicles. I think it will be easier to do autonomous driving with trucks due to the nature of long-distance and interstate travel. It becomes too complex in cities, and that is likely where a human would have to intervene.

The business model would be very similar to a computer. It will likely become the equivalent of Apple outsourcing the manufacturing of its iPhones. People investing in autonomous vehicles will outsource the hardware and then will themselves put the brains in the car in terms of software, LiDAR, Radar, etc. All the profit will shift to software and to the technology of the car. The question then arises as to how you charge for the service. You might have a subscription model to allow for consistent updates of the system.

We have an indirect stake in Waymo through Alphabet. Waymo is, however, quite small in the life of Alphabet. We should be considering investing in GM, or we could go the supply route such as with Aptiv. I do not think it is too early. Would we invest in some of the German car companies? I do not think so. We would not want to go through an ICE company, unless it is GM in which Cruise is a separate entity.

Nick Dennis

I am biased based on the research that I have done, and I believe that Tesla's approach is a million times harder than Waymo's approach, but that it is also infinitely more scaleable. Waymo's LiDAR and HD mapping could work, but how do you roll that out to 10,000 cities around the world? I do not believe that scales properly.

Tesla is going full vision and getting rid of radar. The reason why I think its model is very powerful is because I believe that it learns better than the Waymo model. Tesla has a lot of cars on the road that give it the experience to edge/corner cases and gives the company data on these situations. In addition, it has driver intervention with its cars currently on the road, which helps these cars learn in strange situations.

The challenge is that 99% is not good enough. You need to get to 99.9999% and beyond, and it gets harder as you go. I do believe that we will reach a point where it is so much safer than a human driver. With Tesla you could buy the self-driving feature upfront, but you pay US$199/month for the feature (which might come down over time). Also, for Tesla that is 100% margin revenue with the subscription model. It becomes more like a software company over time.

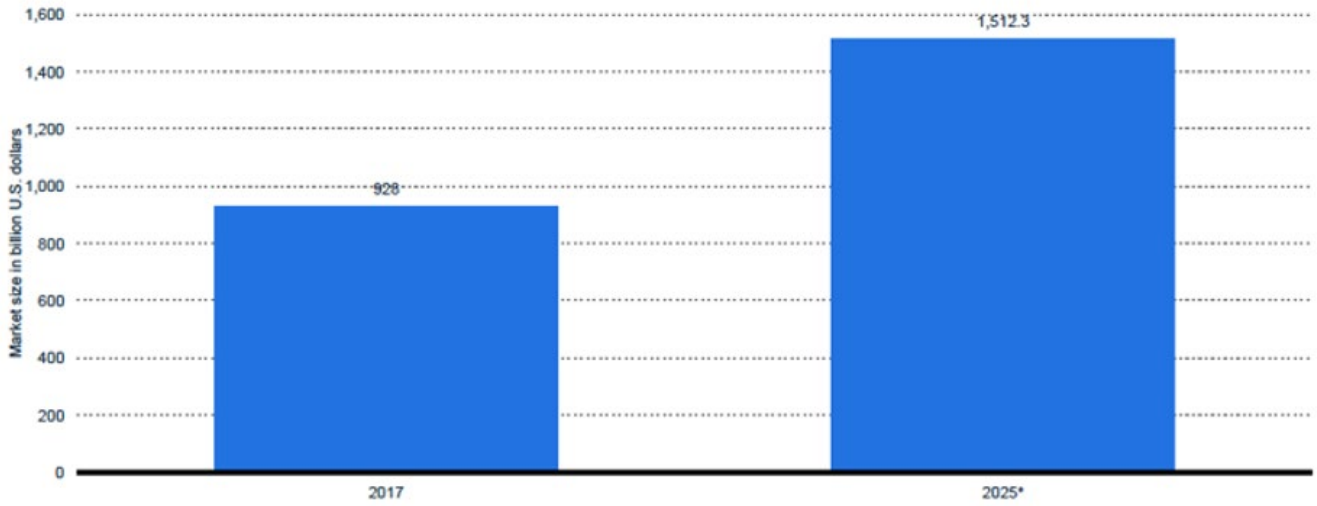
Where it gets interesting is when I have 5 Teslas and I pay for self-driving every month and I can send them out on the road as robotaxis. Then I can earn while I am at home or at the office. Those cars could earn me an income for the next 10 to 15 years. It seems like science fiction now, but these things enter the world exponentially. The rollout will just get faster and faster.

From an investment perspective, it is tricky because the market always looks ahead. You cannot wait until it is obvious because then it is already priced in. In terms of my thesis, autonomous is the cherry on the top. Even if it does not happen, I think Tesla will deliver very nice returns due to its battery and vehicle production. If you layer on self-driving and robotaxis I think it will become one of the biggest companies in the world.


RENEWABLE
ENERGY

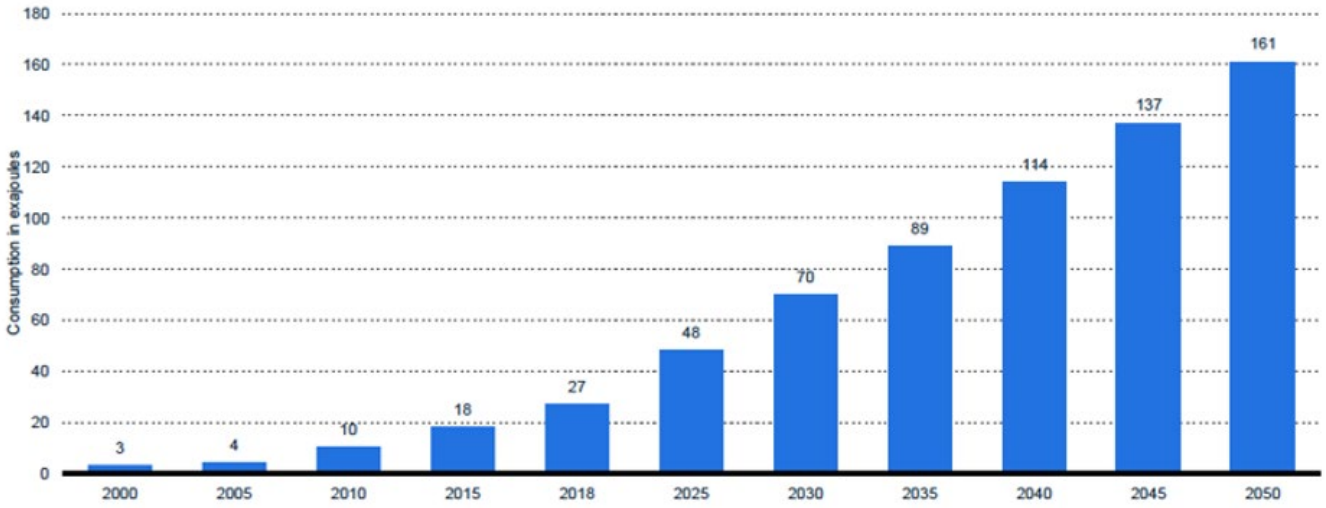
Facing the crisis of global warming, the world is growing ever more restless for alternative sources of energy that do not require fossil fuels. The most popular forms of renewable energy include solar and wind energy.

Figure 13: The size of the renewable energy market worldwide in 2017 and 2025, US$bn
Source: Statista



By 2025, the size of the renewable energy market will be nearly double its size in 2017. It is clear from the trends through the 2010s that renewable energy is becoming a massive focus for governments and companies around the world. By 2019, renewable energy made up 13.4% of global energy generation. If we include large hydropower, it increases to over 25%.

Figure 14: Renewable energy consumption worldwide from 2000 to 2018, with a forecast until 2050 (in exajoules)
Source: Statista



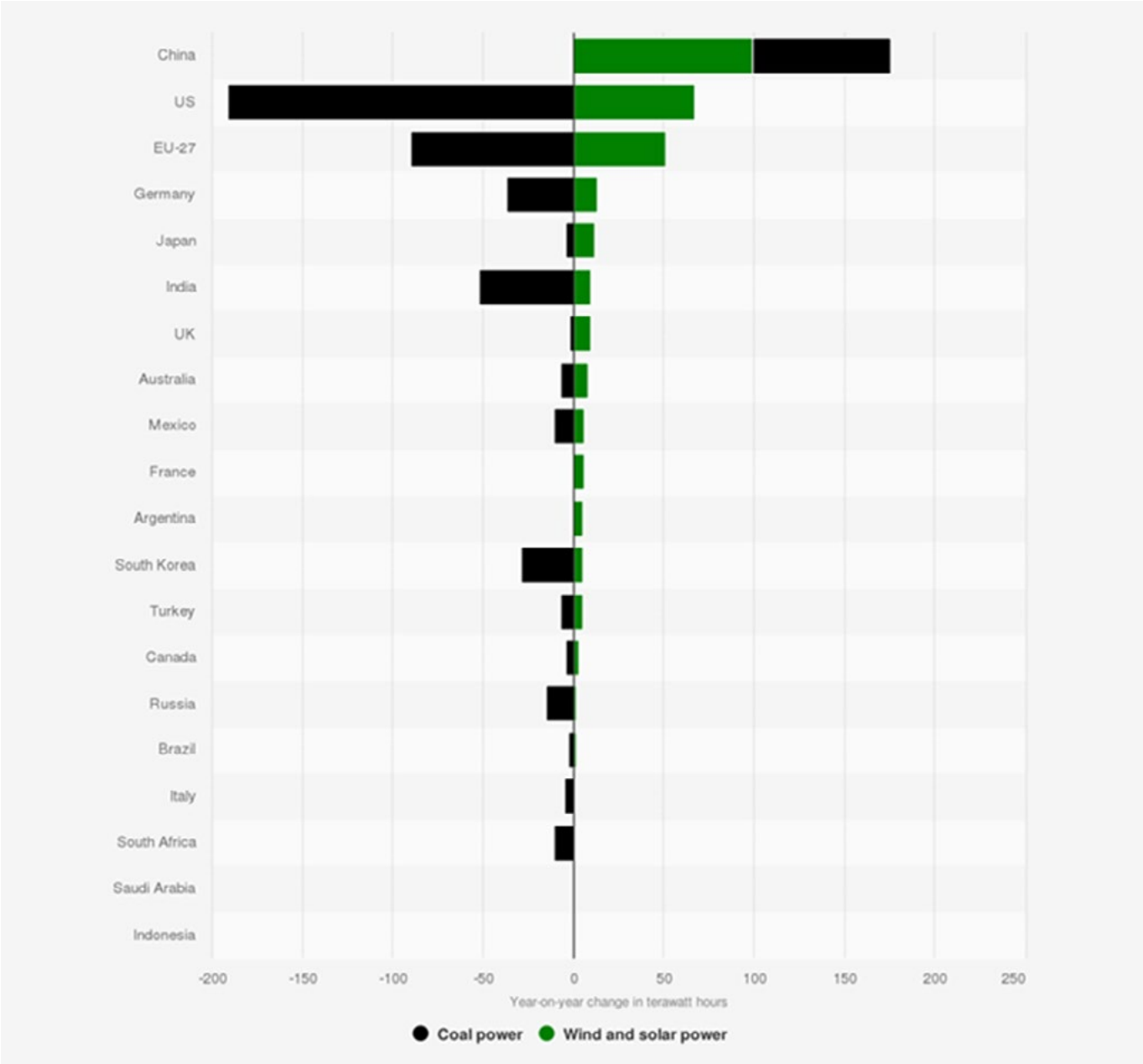
In terms of future projections, we can see a clear increase in worldwide renewable consumption until 2050. This is likely because of an escalation in the shift to renewables, combined with growing populations and increased demand in developing nations. Currently, the demand is centralised in developed nations but with China leading the world in renewable energy consumption. Thus, there is a big opportunity to bring renewable energy to the developing world.

Utilities in these nations have been experiencing similar success. In Europe, many utilities are supplying some portion of their electricity from renewable resources.

We also have to consider which countries are simultaneously moving away from coal and other fossil fuels and replacing them with these new renewable forces. Statistics from Ember show the changes in coal, solar, and wind energy production from 2019 to 2020. According to these statistics, we see China increase both its coal and renewable energy generation – this is important to note as many statistics show China leading in renewable energy generation, however, the demand from the country for electricity requires it to continue using coal as well.

This is because of the nature of renewable energy. There is an element of 'interruptibility'. Wind and solar power cannot operate alone without being accompanied by on-demand, fossil-fuel-based energy (or effective energy storage) because they are not constant. The two often work together, and the increase in renewable energy does not mean a decrease in fossil fuels. As seen in *Figure 15* below, China increased its energy production in both coal, wind, and solar between 2019 and 2020.

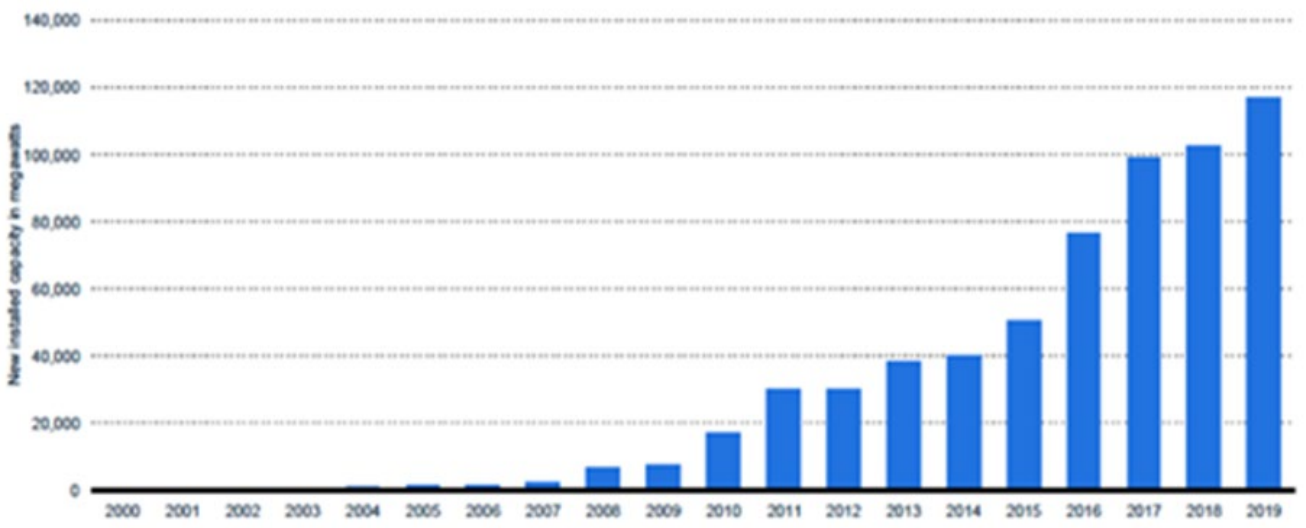
Figure 15: The YoY change in coal power production and wind and solar energy production in the G20 countries between 2019 and 2020 (in terawatt hours)
Source: IEA, Ember, Statista



Solar energy

Solar energy is radiation that comes from the sun, which is capable of producing heat, and subsequently can produce electricity. Through solar panels, technology can transform the sun's energy into electricity that we can use in our everyday lives. Difficulties in battery technology, as well as the cost of panels and installation, have made exponential growth difficult, but the 2020s could see a dramatic change in this industry and in renewables as a whole.

Figure 16: Global new installed PV capacity from 2000 to 2019 (in megawatts)
Source: Statista



Recent statistics have shown positive results for solar power generation. In Figure 16 above, as reported by Statista, capacity has been increasing steadily since 2010, with big leaps happening in the latter part of the past decade.

When it comes to solar power, we must make some distinctions in order to understand the statistics.

Photovoltaic (PV) solar panels are different from concentrated solar thermal systems (CSP). These are the rooftop panels we see commonly in our everyday lives. PV solar panels make use of the sun's light through photons, or particles of light energy. We have an energy conversion from light energy into electrical energy. This produces direct current, which can be converted into alternating current.

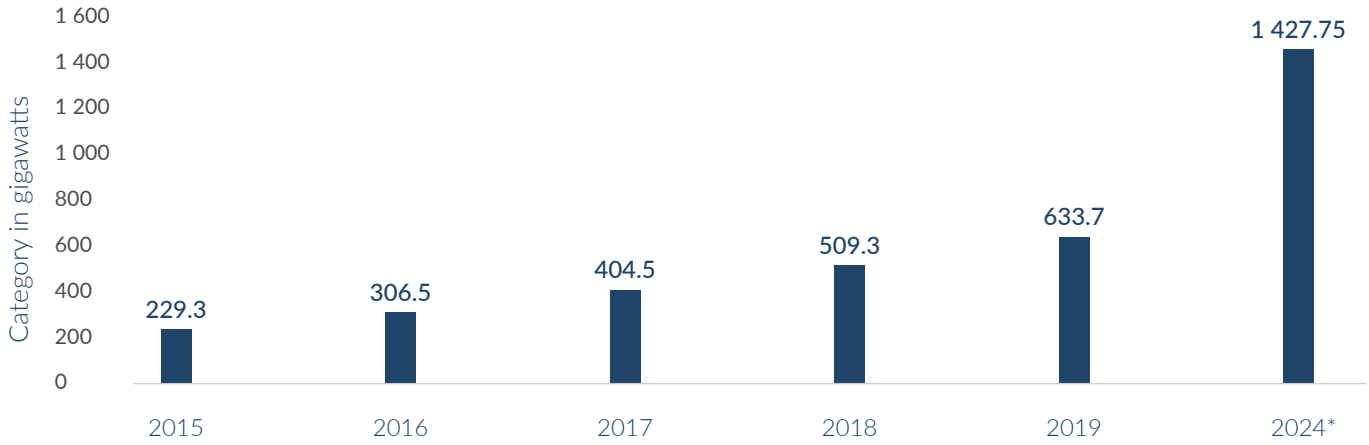
CSPs have a different energy transformation. In PV panels we convert light energy to electrical energy. With CSP, we use mirrors to convert light energy into heat, which can then be used to heat water into steam to drive a turbine, which can then generate power. Instead of a direct conversion from light to electricity, we go from light to heat to electricity. This produces alternating current.

However, even with these options, the cost has continually been a problem. National Geographic reports that the problem comes with scale. Small home installations do not take advantage of bulk buying. The equipment also requires very advanced manufacturing due to the technicalities that come with purifying silicon.

PV solar has decreased dramatically in cost over the past decade and is a lot less expensive compared to CSP. This is largely due to the important difference between the two - **CSP does not compete with PV, but rather other thermal power plants.** Although CSP makes solar electricity by harvesting sunlight like PV, it operates more like a conventional power plant. Once the sunlight is collected as heat, the actual power plant works the same as any other thermal energy power station – such as ones that use coal, natural gas, or nuclear power. CSP plants, because they are focused on the large-scale generation of electricity and the integration of thermal storage devices and possible hybridisation with fossil fuels, are meant to produce a large amount of supply to satisfy a large portion of demand.

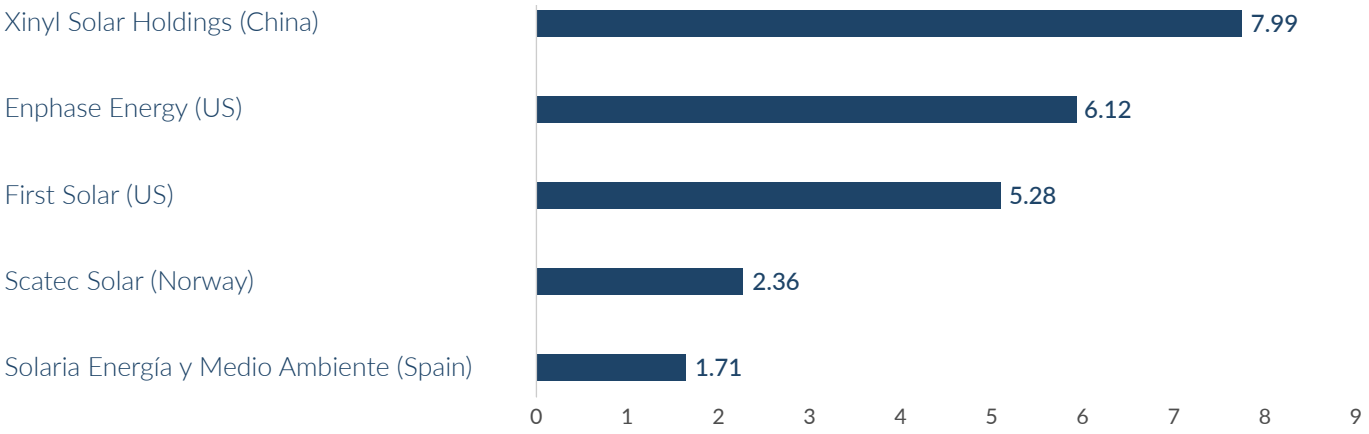
Until 2024, the prospect of solar energy looks very promising. However, looking at *Figure 17* below, by 2024 the cumulative installations of solar PV might double from 2019.

Figure 17: Forecast of cumulative installations of solar PV capacity worldwide from 2015 to 2024 (in gigawatts)
Source: Statista



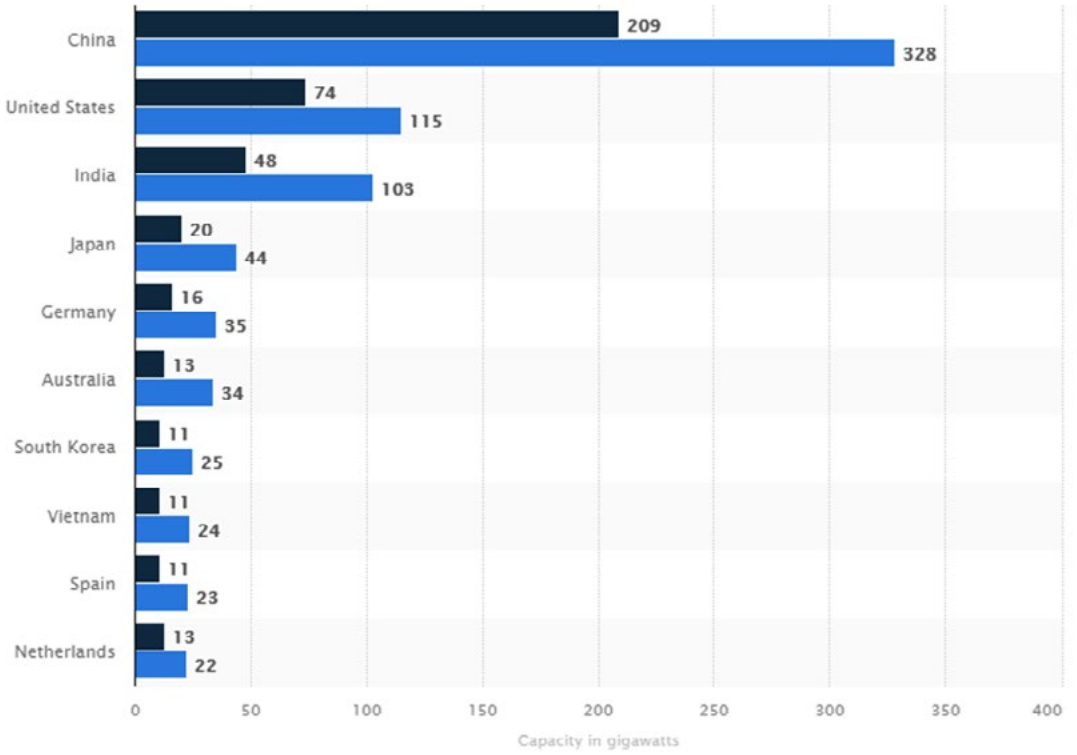
The current solar energy market

Figure 18: Ranking of solar companies based on market cap globally as of 2 July 2020, US$bn
Source: Statista



In terms of market cap, we see that companies from China and the US dominate the current market. Overall, Europe and North America have made great leaps in solar energy, but China is consistently showing major success as well. This correlates with what we saw at the beginning of this section, in which China increased the most, not only in its renewable energy production, but also in its coal energy production.

Figure 19: Projected new installation of solar PV capacity worldwide between 2020 and 2024 by select country (in gigawatts)
Source: Statista



Similarly, China is projected (in both a bear and a bull case) to have the highest number of new installations of solar PV between 2020 and 2024. Developing countries like India and Vietnam are also forecast to largely contribute to new installations before 2024, indicating that it is not just developed nations that are joining this trend.

Other sources, such as statistics from IRENA, have pointed out that Australia's solar power will comprise 40% of its total power generation by 2050. In this outlook, China will only be at 23% solar power, and the US will be at 33%. This outlook places SA at 26% solar power by 2030, and 32% by 2050.

Wind energy

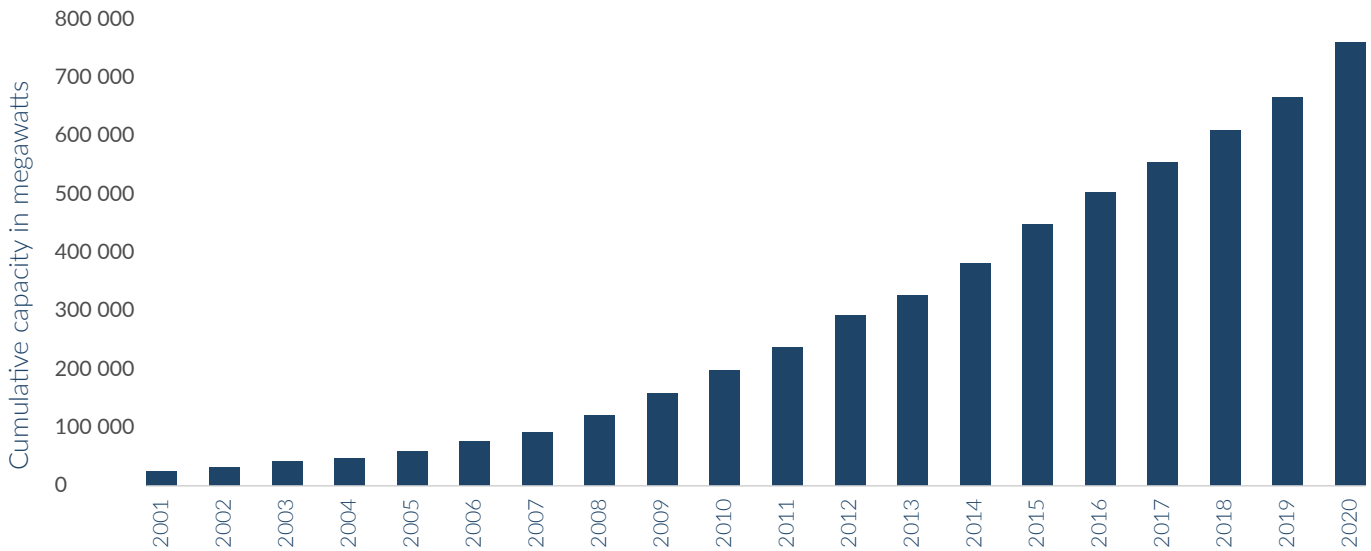
Wind energy is one of the fastest-growing energy sources in the world. The process is quite similar to solar energy in that we harness one type of energy to turn it into another. The wind hits a turbine's blades, causing the turbine to turn. The rotational movement, being kinetic energy, moves a shaft that is connected to a generator. This allows electricity to be produced through electromagnetism.

As with most renewable energy sources, wind is an unlimited source of energy thereby making operational costs extremely small once the turbines have been erected. Mass production and technology advancements are making the turbines cheaper every year, alongside many government tax initiatives.

The industry has been divided between onshore and offshore wind power. Onshore energy requires turbines installed on land, whereas offshore refers to turbines over open seawater that harness the power of faster winds. The difference between these two types comes in the form of cost and consistency. Offshore wind farms require platforms for the turbines and underwater cables to transport the generated electricity. Maintenance for offshore wind farms also requires staff transportation on either a helicopter or a ship. Onshore generation, while cheaper, can be slightly less predictable. To effectively install onshore farms, one must study the terrain and wind currents to ensure that power can be generated consistently. You have to build the farm in a place where electricity generation can happen. Offshore farms enjoy more consistency because there are constant winds with higher speeds.

The wind energy market was valued at US$90.11bn in 2019 and is expected to grow at a compound annual growth rate of 5.34% to reach a total size of US$123.15bn in 2025.

Figure 20: Global cumulative installed wind power capacity from 2001 to 2020 (in megawatts)
Source: Statista



Since the early 2000s, the increase in capacity in megawatts has been astronomical, as more and more countries adopted wind power into their electricity production. In 2016 alone, wind power accounted for 16% of the energy generated by renewables. The reason for this dramatic increase in wind power usage is likely connected to its decreasing cost. Just as with solar power, wind power has become increasingly inexpensive throughout the past decade, making it a more attractive option around the world.

Figure 21: Weighted average cost for installed onshore wind energy worldwide from 2010 to 2020 (in US$/kilowatt)
Source: Statista

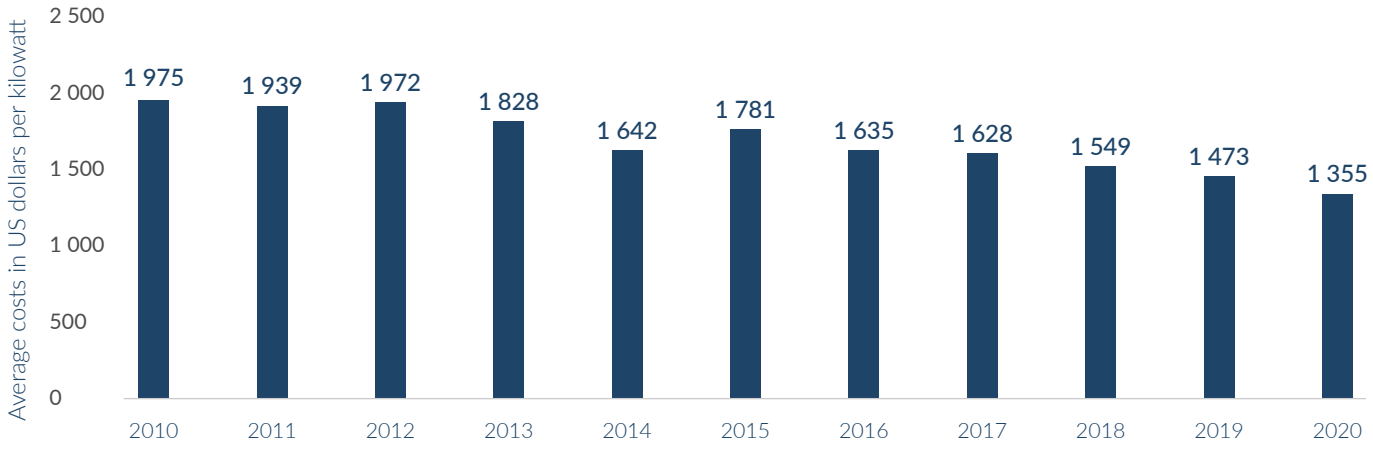
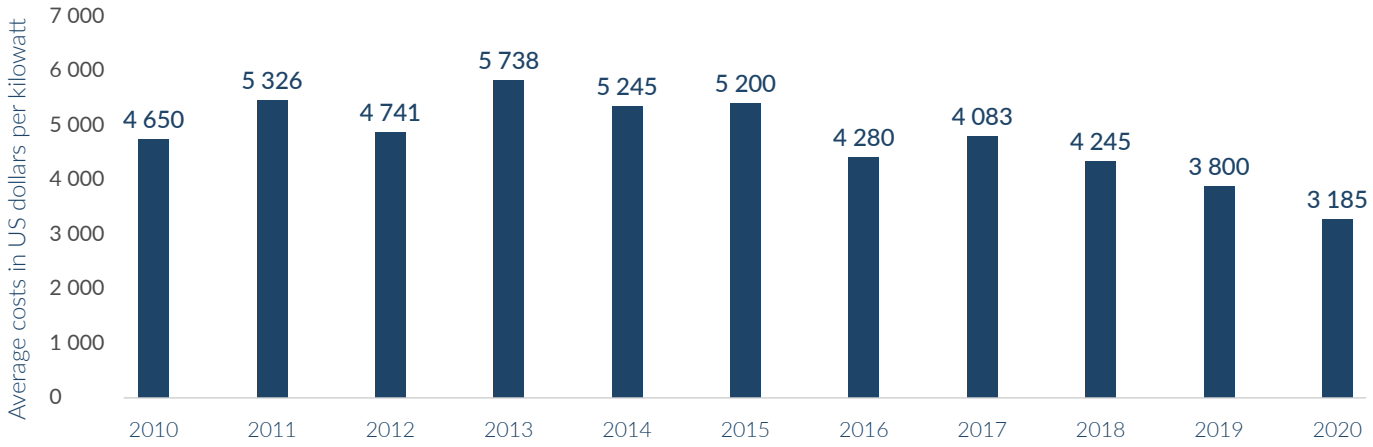
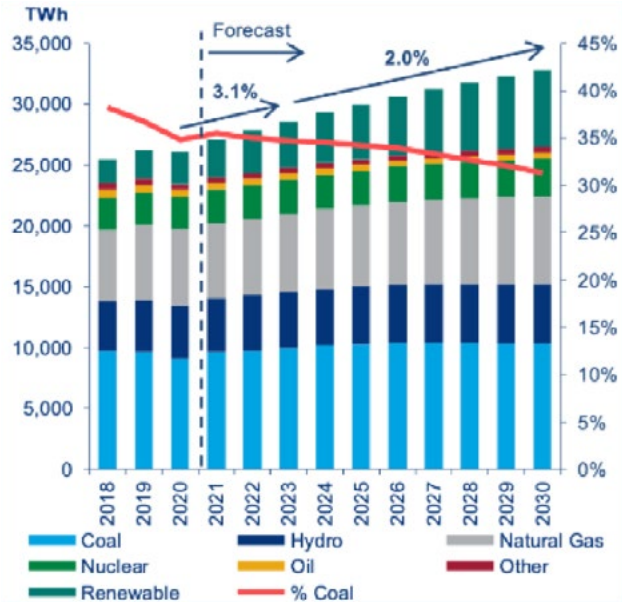


Figure 22: Weighted average cost for installed offshore wind energy worldwide from 2010 to 2020 (in US$/kilowatt)
Source: Statista



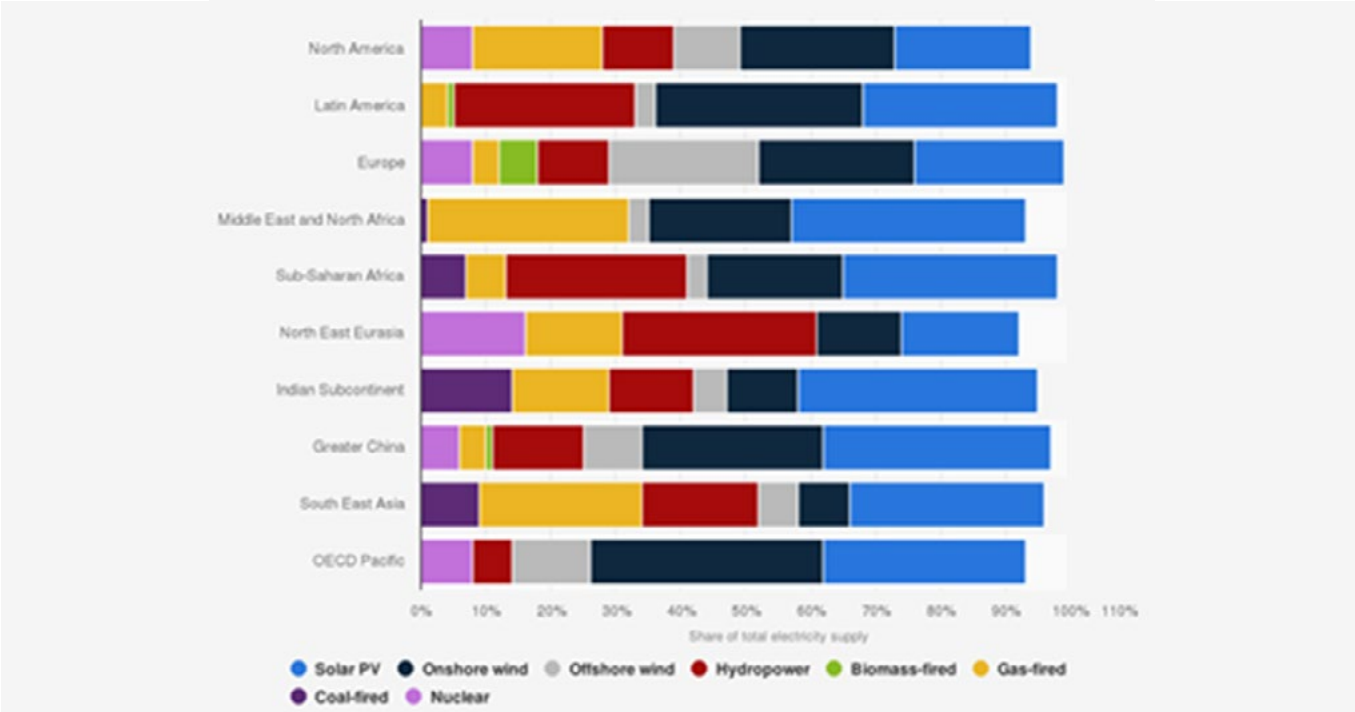
It is projected that global annual wind power capacity will rise from 93,000 megawatts in 2020 to 112,224 in 2025. By 2050, both onshore and offshore wind will be responsible for 20%-40% of power generation in most regions globally. Alongside solar power and hydropower, the world will scarcely require coal or gas-generated fuel by the middle of this century. However, there is another opinion held by SA company, Thungela.

Figure 23: Weighted average cost for installed offshore wind energy worldwide from 2010 to 2020 (in US$/kilowatt)
Source: Thungela



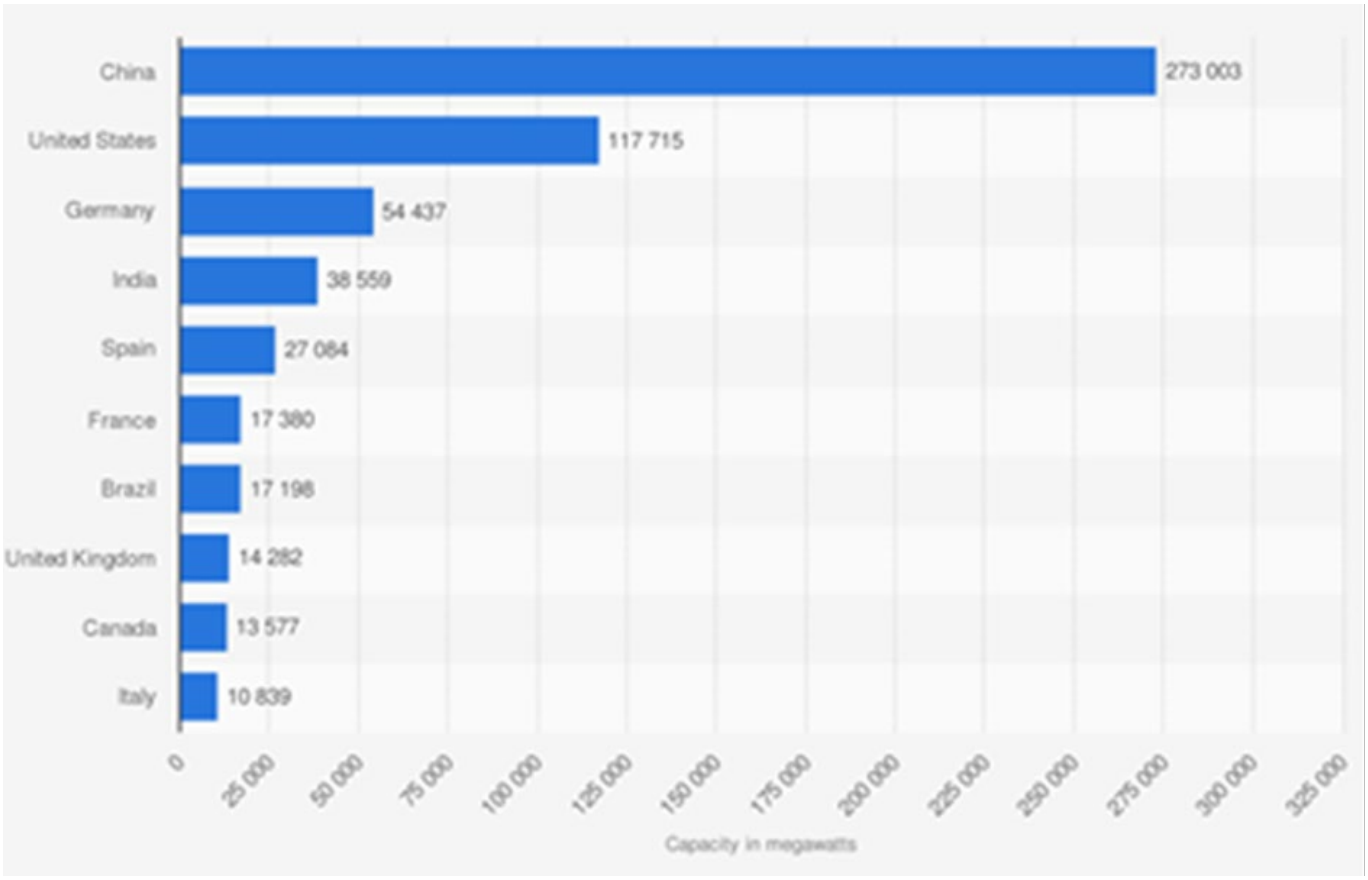
In its pre-listing statement, Thungela indicated that the decrease in fossil fuel usage might not be as dramatic as some predict. Previously the SA thermal coal business of Anglo American (it was spun out in June 2021), it claims that the use of coal will remain consistent until 2030. It also published a report stating that renewables will definitely increase, but this does not mean that fossil fuels are going away. With larger and increasing populations requiring more electricity, this perspective does make sense intuitively.

Figure 24: Forecast electricity supply by source in 2050, by region
Source: Statista



The current wind energy market

Figure 25: Global onshore wind energy capacity in 2020, by country (in megawatts)
Source: IRENA



By geography, the global market has been divided into five regions: South America, North America, Middle East and Africa, Europe, and Asia Pacific. Europe was responsible for a significant market share in 2019. The continent has taken a strong liking to the technology, especially in places where solar power is less effective. Concerns on environmental sustainability across EU member states with targets focused on reducing the dependence on non-renewable energy sources is boosting the capacity of wind turbines in the region.

Denmark's Vestas, the 2018 market leader, has been operating since 1945. It was also the largest onshore wind turbine manufacturer, in terms of commissioned capacity, in 2019. However, in terms of revenue for 2019, China's Goldwind and the US' GE Renewable energy performed better. Goldwind earned US$34.61bn, followed by GE at US$15.34bn and then Vestas at US$13.6bn.

Investment thesis: why invest in renewable energy?

1. By 2024, the cumulative installations of solar PV are expected to double from their 2019 levels.
2. The World Economic Forum predicts that, by 2030, there will be US$1.2trn-plus invested p.a. in renewable energy, more than five times the investment into fossil fuels.
3. By 2025, the size of the renewable energy market will be nearly double its size in 2017.
4. The World Economic Forum forecasts that solar energy costs will halve by 2030.
5. Solar power could produce up to 25% of the world's power by 2050.
6. The wind power market was valued at US$90.11bn in 2019 and is expected to grow at a compound annual growth rate of 5.34% to reach a total size of US$123.15bn in 2025.
7. It is projected that the global annual wind power capacity will rise from 93,000 megawatts in 2020 to 112,224 in 2025.
8. By 2050, both onshore and offshore wind will be responsible for 20%-40% of power generation in most regions around the world.

Points of concern: what might make investing risky?

1. Solar and wind are inconsistent in nature.
2. The cost is still a factor today for many renewable energy projects. Costs may still need to decrease significantly before they can become truly profitable.
3. People protest the construction of wind turbines – saying that they are not appealing and make a lot of noise.
4. According to *Horizon Kinetics'* 3Q20 commentary, onshore wind turbines typically operate only 25% of the time, and offshore turbines c. 40%. This means that a 'shadow' fossil fuel plant must accompany each set of wind turbines to provide electricity to the grid when these turbines are not producing. That fossil fuel power plant has to be an always-on, base-load plant, so it constantly burns fuel.

What do the Anchor experts say?

David Gibb

A large percentage of global emissions comes from electricity generation. Renewable energy can partially fix this problem but wind and solar are still relatively small in global electricity generation. Neither can be fully responsible for all electricity due to their intermittency, but it can go to a much bigger number than it is at today.

This is largely a hardware industry. Do you make a lot of money out of this industry? That has not been the case up until now. If you are making wind turbines, it is a fairly concentrated market between Europe and the big Chinese players. There are also a lot of complaints about the view and the noise, which is why on-land wind might be difficult. Wind at sea is a bigger growth generation market. This also depends on the continental shelf – if the shelf falls away too quickly it becomes more difficult which is why the UK wants to become the Saudi Arabia of offshore wind. It is also just starting in the US.

Wind will be an enormous market. It is not only hardware but also cabling and transmission and it is a lot more technical than just the wind turbine. Many approvals are required. This means it will take a long time, but the momentum is enormous. At this stage they are all low-margin businesses – they aim for 10%-12% but it is usually less than that. I do not know if we are going to make money out of these companies since it is not a great quality business because you are making heavy equipment.

It might be a reasonable time to get involved already because inflation has picked up globally. We might be getting to the point where they will be reasonable investments and where the revenue growth will be quite good. However, we are not 100% sure about what the margins are going to do.

The good thing is that there are currently only about five players outside of China. So, we would be interested in Siemens Gamesa, Vestas, and probably GE. We do not have exposure currently, but we have been considering it.

In terms of solar, this market has been dominated by the Chinese, which makes it difficult to compete in. It is really about solar panels, and the key here is that the price of a panel has come down dramatically. It is difficult to get revenue growth if you manufacture solar panels. The governments of China, Japan, and Germany have created this industry via subsidies. You are also dealing with huge deflation and massive Chinese competitors. For the Western players, you need huge support from your government to get to scale.

You also have to look at other things such as inverters and a ''smart box' that can give you a breakdown of the efficiency in your house. Most of the companies that are currently doing that are quite small, so we battle to find businesses to invest in when it comes to solar. I also question the quality of all the companies in the renewable space.

Ross McConnochie

One point to mention with green energy and solar is the deflation in prices and how that impacts an investment thesis. Businesses that produce solar panels may be making them cheaper and cheaper but, because of heightened competition, they cannot maintain their profit margins and hence they make less profit on these sales although they do have higher volumes. So, one must be careful in picking which part of the industry you invest in. Perhaps the green energy utility companies are a better investment option because their input costs are going down whilst they do not need to reduce what they charge customers as energy demand continues to rise. A business such as NextEra Energy is a good company from that perspective.

Seleho Tsatsi

There is a company called Thungela, which was spun out of Anglo American and listed earlier this year. It is a thermal coal business, and its view is that, although the world views thermal coal as a dirtier source of energy, the energy needs of big economies are growing quickly, and those needs have not yet been met by renewable energy. There is still demand for thermal coal in Asia, and it is forecast to possibly grow over time. From a financial perspective, it is still a good industry to be in. The world looks down on it, and rightly so, but it will remain part of the global power mix. Growth in renewables does not necessarily mean a decline in fossil fuels.

Of course, there is also the view that we should not be investing in fossil fuels from an ethical perspective. There is also the question as to whether you want to be the company that is pushing the fossil fuel industry – but from a financial perspective, the numbers can look attractive.

Nick Dennis

There is a desire from some segment of consumers to be environmentally conscious, which is mirrored by regulators. Subsidies do help, but I think it is in fact due to that cost curve coming down that is making renewables so competitive. The regulatory environment will make it tougher for polluting industries, and the cost of capital for this industry is coming down. This creates a positive cycle of effects that allows renewables to take over.

In general, it is very difficult to make money on the hardware side of any business. It becomes easy to copy over time. You get exceptions when you have integrated hardware and software that create something better. There is not a lot of examples out there, but a solar panel is a pure commodity.

I have not personally invested in the renewable space. Where I am watching is if there is a model which leans itself to something that is more differentiated through software. One example from Tesla is its power walls/solar system for residential use, and then software that can sell/buy power to and from the grid, depending on your usage. It adds a layer of intelligence to an otherwise "dumb" piece of equipment. I am waiting for something that is hard to replicate in this space – for a product that is differentiated and provides value. Just because a space has a lot of growth does not make it a good investment.

Liam Hechter

We were invested in Vestas but, in general, it is not as simple to find direct plays on this. There are a few interesting businesses in Europe, but companies like Vestas are seeing their margins squeezed because of the increase in the copper price, which is making renewable energy more expensive. I am sceptical if it will cost too much money to produce renewable energy sustainably. I would definitely play it through copper because it goes across industries.

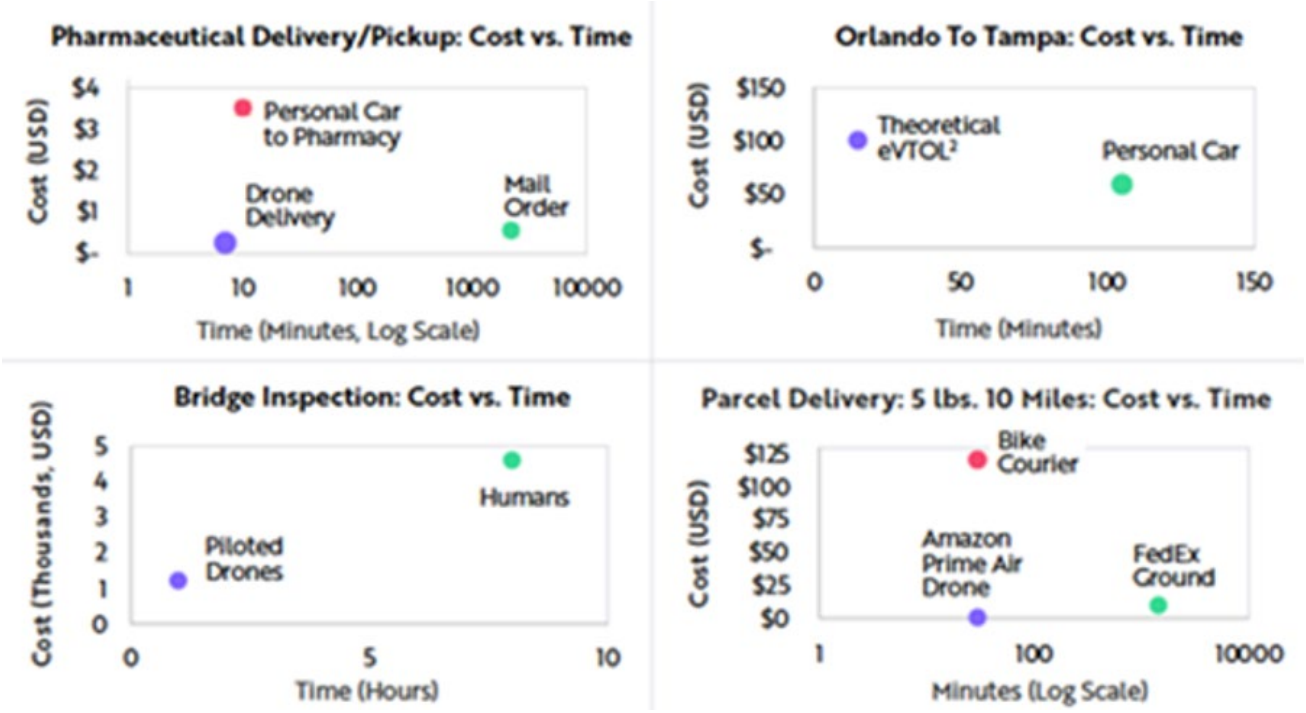
We are also invested in a business in London that has land banked sites for renewables, and it creates the base layer of the land, preps the land site, and gets the right zone approval. It then sells that to the infrastructure company that puts up the solar panel or the wind turbine. It has had great returns and is just another way to get involved in the renewable space without playing it through hardware/infrastructure.

DRONE INDUSTRY

Drones are essentially AVs, but for the sky. With improving technologies, drones can shift from being remotely piloted to being entirely autonomous. This allows for several possibilities including drone delivery, air taxis, air ambulances, etc.

These services have not been commercialised just yet, however, ARK forecasts that drone delivery will be fully operational within the next 5-10 years. The technology provides several advantages in both cost and convenience. As seen in the diagram to the right (Figure 26), drones often reduce both cost and time except in the case of travel – where the cost is slightly more expensive than when using a personal vehicle. The reductions allow for ARK to make several positive forecasts. It believes that drone platforms will generate c. US$275bn in delivery revenues, US$50bn in hardware sales, and US$12bn in mapping revenue by 2030.

Figure 26: Current drone delivery costs at scale relative to competitor costs
Source: ARK



Types of drones

Drones are separated into different categories based on their hardware. These differences mean that they have specific advantages for different industries.

Multi-rotor

These are likely the drones that most people have seen before. They have several fans above their compact body that create lift and give the pilot a lot of control. However, the more rotors you add the more difficult the drone is to control. This also drains power faster, meaning you will not get a very long flight time. You get less than an hour from most multi-rotor drones.

Multi-rotor drones are the cheapest to manufacture, and are easy to control and manoeuvre since they have the ability to hover, can take off and land vertically, and are also very stable.

These types of drones have several uses including:

- Aerial photography
- Filmmaking
- Surveillance

Fixed-wing drone

These drones are more like small planes and thus they require a runway or a catapult to launch. They are a lot more efficient due to the improvement in aerodynamics created by their static wings. This also creates a longer operation time without stopping to charge or swap the batteries – all with the advantage of improved speed. These qualities make them perfect for covering longer distances, especially since they do not have to be limited by batteries and limited battery storage – they can run on petrol engines.

Their advantages include a flight time of 16 hours or more, if powered by fuel, as well as the ability to fly in high altitudes and carry more weight. However, they require training to fly and can only move forward in the air. Due to all of these advantages, they also tend to be more expensive.

These types of drones have several uses including:

- Aerial mapping.
- Inspection
- Agriculture
- Construction
- Security
- Surveillance

Single-rotor

Single rotor drones look like actual helicopters. They have one big rotor above like a helicopter alongside a small rotor on the tail for direction and stability. Their use of rotors allows them to hover and launch vertically, like a multi-rotor drone. Unlike the smaller multi-rotor, the single-rotors drones are bigger and can carry larger payloads. The lack of multiple motors makes them more efficient in terms of energy usage. They often use fuel rather than batteries, which also increases range.

These types of drones have several uses:

- Research
- Aerial LIDAR laser scan.
- Surveying

According to Levitate Capital, to operate a drone in the US, the operation must follow or exceed part 104 rules.

To operate the controls under the rules, an individual must be:

- at least 16-years-old;
- able to read, write, and speak English;
- in the physical and mental condition to safely fly a drone; and
- pass the initial aeronautical knowledge exam

There are also general rules for drone operation in the US and similar rules are enforced in the UK and Australia.

These rules include:

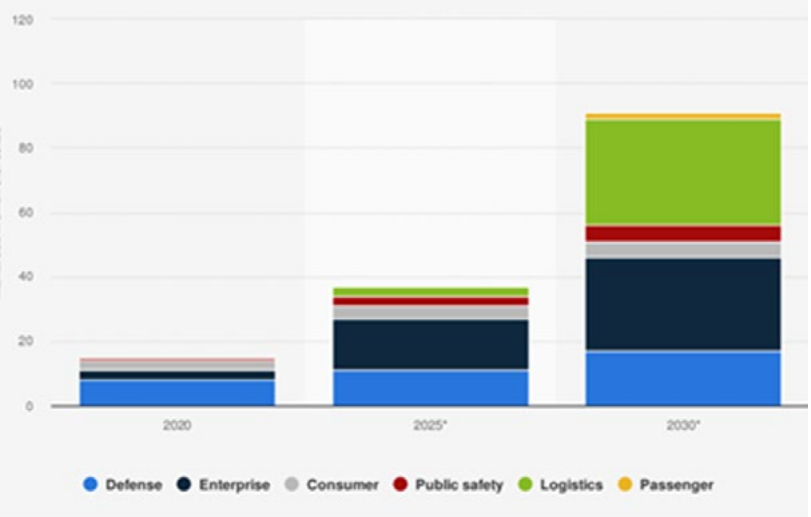
- Flying in visual line-of-sight only
- Having 1 pilot per drone
- Reaching only a maximum of 400 feet above ground
- Only being allowed to fly over people directly involved in the operation

Drones in different industries

Defence

Today and by 2030, Defence and Enterprise will be the two sectors most heavily involved with drones. According to Levitate Capital, this is due to a global increase in defence spending, most of it stemming from the US. In 2019, the US accounted for 39% of drone spending globally.

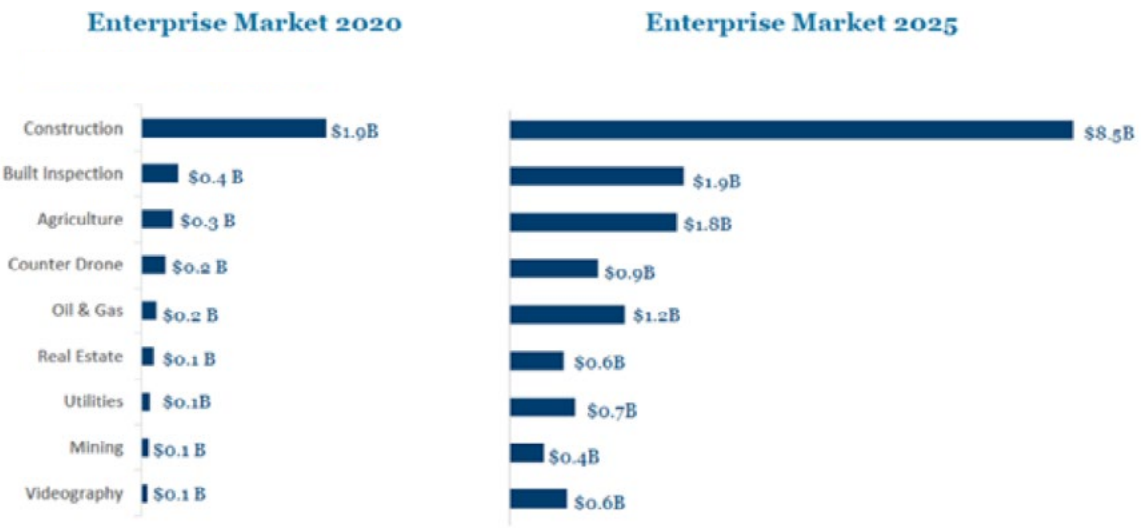
Figure 27: Drone market size worldwide from 2020 to 2030, by segment (US$bn)
Source: Levitate Capital



Enterprise

Drones for consumers have been available since 2013, but it has only been illegal for drones to fly for commercial reasons since 2016. At present, most programmes in the enterprise sector are still in their infancy. There is currently a large amount of regulation regarding drones, such as flying within a visual line of sight and only being permitted to fly in specific areas. This, alongside costs with regards to procurement, training, and data collection, makes it difficult for companies to fully adopt a drone programme.

Figure 28: Drone enterprise market, 2020 vs 2025, by industry (US$bn)
Source: Levitate Capital Analysis



Construction

Drones can change the architecture, engineering, and construction industry in the following ways:

- By allowing for remote site monitoring and progress reports.
- Software can construct accurate twins of the project to be compared against 3D models and expected progress.
- Drones can map out the terrain to determine feasibility at a fraction of the cost and time to produce topographic maps using helicopters or land surveillance.
- Using thermal sensors, drones can detect leaks, electrical issues, and other anomalies.
- Drones can monitor sites and increase security to protect equipment.

Agriculture

Precision agriculture can be defined as "the application of modern information technologies to provide, process, and analyse multisource data of high spatial and temporal resolution for decision making and operations in the management of crop production." Essentially it is the science of improving crop yields. It refers to the way farmers manage their crops to ensure the efficiency of their inputs such as water and fertiliser as well as minimising unwanted flooding, pests, and disease. This helps farmers maximise the productivity, quality, and the yield of their crops.

Drones can change the world precision agriculture in the following ways:

- By planting or irrigating crops.
- Through soil and crop monitoring.
- By doing health assessments.
- Data can inform farmers when to plant, treat, and harvest their crops.

Logistics

This refers to the possibilities of drone delivery, which could become the largest drone market in an economy. Currently, routine autonomous delivery is unlikely to occur before 2023 – but significant progress has been made. UPS and Matternet, a provider of drone-based logistics services in urban environments, have joined forces to deliver medicine from WakeMed's hospital in Raleigh and recently announced its expansion to the University of California San Diego health system. Wing, a subsidiary of Alphabet, has also been granted approval to commence its delivery service in Canberra.

Investment thesis: why invest in the drone industry?

1. *ARK* believes that drone platforms will generate c. US$275bn in delivery revenues, US$50bn in hardware sales, and US$12bn in mapping revenue by 2030.
2. By 2025 more than 250,000 of the 570mn farms in the world will be using drones in some or other capacity.
3. The market for drones in smart or precision agriculture is expected to reach US$4.8bn by 2024.
4. *ARK* predicts that, in the next 5 years, drones will deliver nearly 20% of all parcels globally.
5. Parcel delivery by drone is expected to increase to the value of US$115bn by 2030, according to *ARK*.
6. Revenue for global food delivery by drones will reach US$116bn by 2030, according to *ARK*.

Points of concern: what might make investing in drones risky?

1. Job losses due to drones replacing workers in agriculture.
2. Drone regulation is not being implemented fast enough to allow for increased use.
3. Restrictions on where drones are allowed to fly and at what times.
4. Implementation for smaller companies without large R&D budgets will be difficult as it requires significant capital outlay.
5. You only reach economies of scale using/buying drones if your operations are extremely large

What do Anchor's experts say?

David Gibb

We have not yet invested in drones. There is a military link here, as seen in the recent battle in Libya. Drones come from a military foundation, which is why Israel has been so strong when it comes to drones. China dominates when it comes to the smaller drones that are available for everyday consumers.

There is a huge possible application for drones but, once again, it is hardware and China has gotten in there early. If you are talking about big drones for delivery into remote places and for the military, it will be difficult as well and I am not sure about the investible opportunities here.

There are a lot of drone trials going on currently, such as with Google in Australia. The US and the UK will be keen to approve drones for delivery, which will be great for global warming as well. However, you have to watch out for air space – the industry will be heavily regulated. It makes it easy for remote work but, in heavily populated areas, it will be difficult.

Who will make the money? It will be a cost saving for delivery companies, but it is still not clear whether it will be possible in cities due to regulations.

Ross McConnochie

I have not really thought about drones very much. I would imagine that the most appealing part of this is military application. I do not really think that drone deliveries will become a reality for a very long time. I just cannot see a government letting drones fly around a country without heavy regulation. Imagine the chaos. In terms of farm use, that could be a big push to driverless machines as we already see harvesters that operate without humans etc. But that does not mean that they all have to be "flying" drones.

Nick Dennis

You could see a combination of drones and AVs when it comes to Amazon deliveries or industrial uses such as mining and agriculture. I see it as becoming more like a cash register or ATM. It will be very good for the customers who buy the drones as opposed to the manufacturers of the drones. I think it could also become a commodity, like renewables and the hardware there. It needs to go beyond manufacturing a commoditised item.

I think the regulation problem will solve itself. It is easy to say regulators will not allow it, but governments a century ago were worried about regulating automobiles. The regulation will follow, just a bit slower. Certain countries such as China will likely lead the way. There will definitely be incidents that threaten the safety of people, but this is a cycle that happens with every new technology.

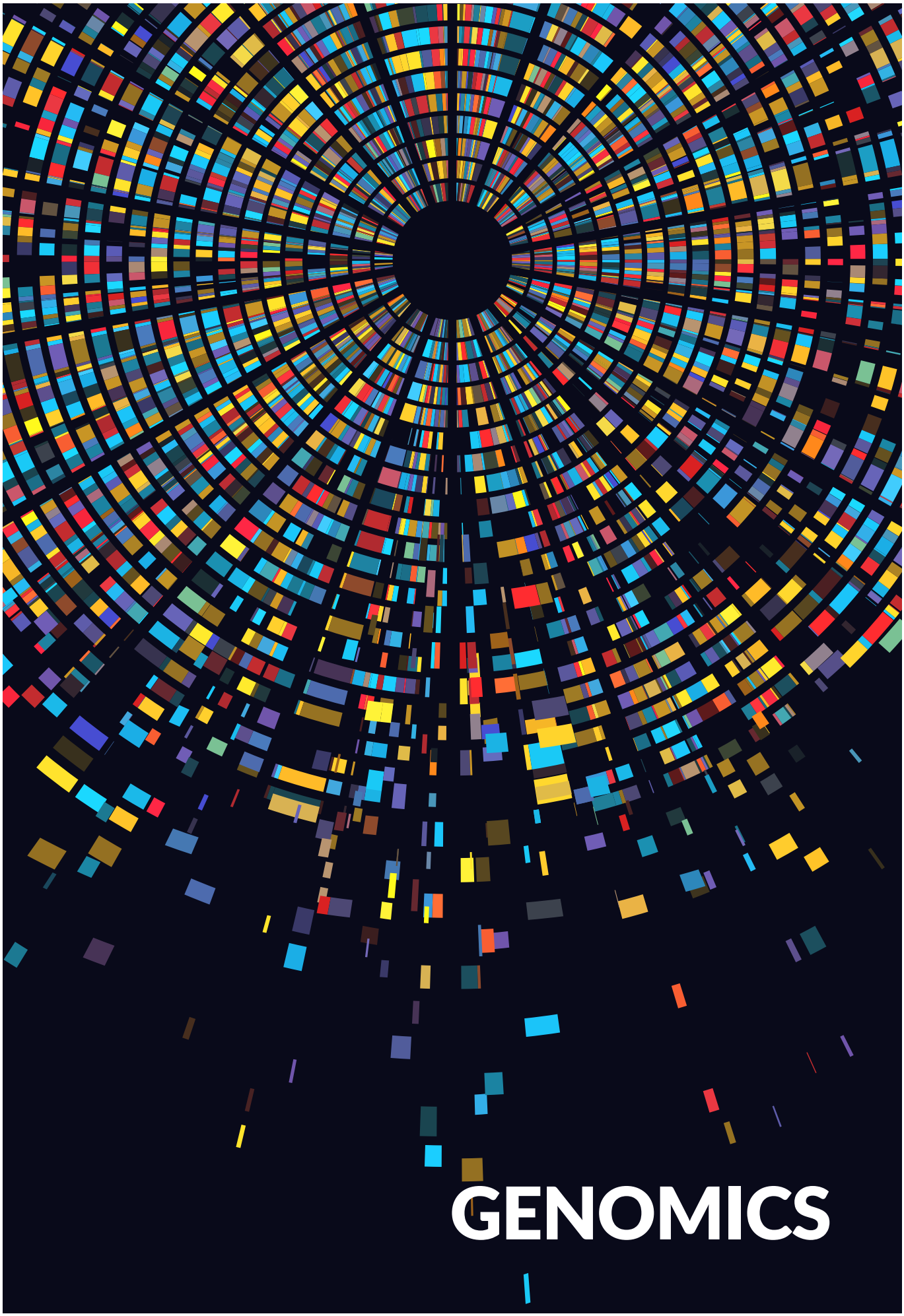
Henry Biddlecombe

Obviously, companies like Uber, Amazon, and food delivery businesses are investing research in these companies, focusing on delivery drones as well as warehouse drones. Amazon bought two companies - Canvas Technology and Kiva. This means that they will be used to displace or replace human labour.

If you look at Amazon, it has used drones in such a way that it works for them. The technology is expensive and intuitively it does not make a lot of sense. However, by spending all that money it means delivery speeds are increased and it gives Amazon, for example, an incredible competitive advantage. Amazon will reach a scale where that investment becomes economic, where it would not if it was a smaller player. Amazon is outspending everybody else to the extent where nobody can keep up. This is where drones can impact the general consumer market.

A flying drone that delivers goods through the air sounds like a ridiculous notion, but a company like FedEx, for example, does not have the cash to burn to chase that pipe dream. Amazon does have that capability and the capacity to experiment with drones. If anybody is going to get there first, it will probably be Amazon.

However, this is not really a drone investment. If you invest in Amazon, you are investing in a company that is using drones and benefitting from them, but it is indirect. Drones are a difficult space in which to invest in the public markets because there is a lot of hot capital in private equity markets or in the angel investor market, chasing that space.


GENOMICS

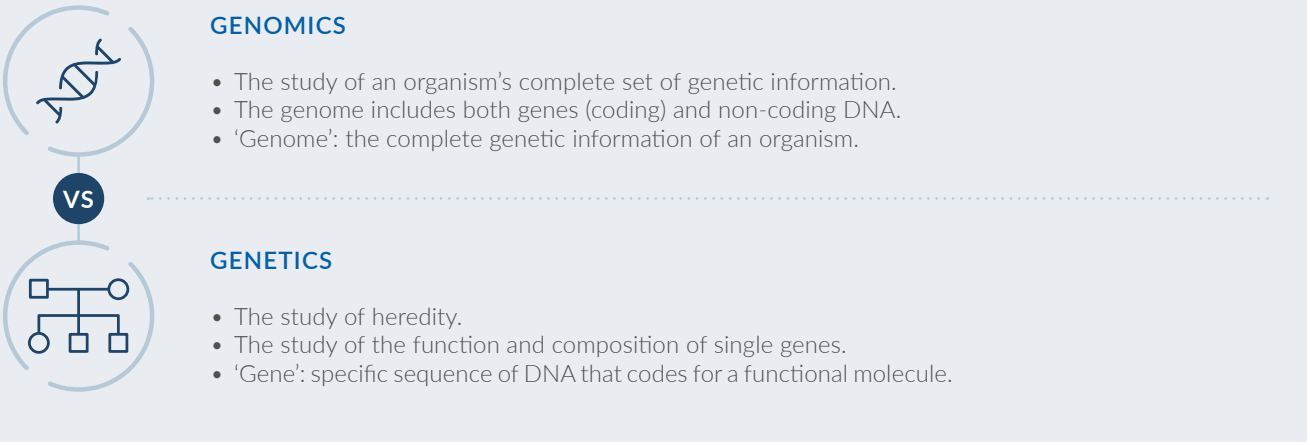
Going into genomics requires a basic understanding of two concepts:

DNA, the abbreviation of deoxyribonucleic acid, is the organic chemical of complex molecular structure that is found in all prokaryotic and eukaryotic cells and in many viruses. DNA codes genetic information for the transmission of inherited traits.

A genome is the full complement of genetic material within an organism.

These two definitions form the ultimate difference between genetics and genomics. Genetics is the study of genes and their role in inheritance – what parents pass down to their children such as hair colour, eye colour, height, etc. Genomics is a broader term that takes into account all the DNA in an organism's genome – it includes genetics and other studies. Genomics is how we read and interpret the DNA that stores genetic information in ALL living cells.

Figure 29: Genomics vs genetics – an explainer
Source: Genomics Education

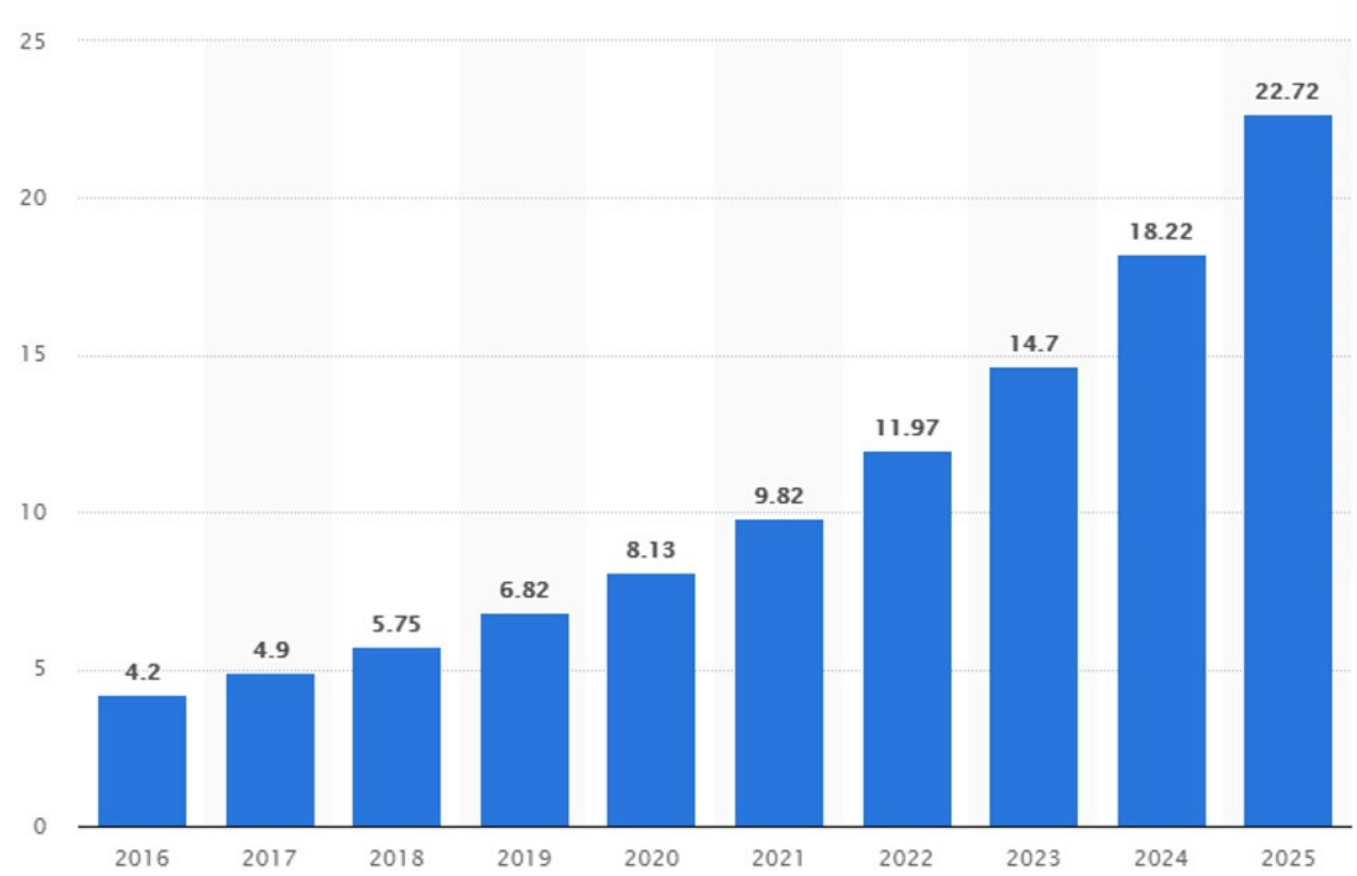


Going into detail in this field is incredibly difficult for an uneducated author – thus we will give only a brief overview and then rely on expert opinions to elaborate further.

Thanks to the results of the human genome project, scientists now understand all of the genes that make up homo sapiens – or a complete understanding of our genome. With this understanding comes many controversial powers, such as:

1. helping scientists understand human genomic variation – what makes us different and what makes us the same;
2. cancer being caused by changes in your genome, therefore an increased understanding of the genome has revolutionised diagnoses as well as treatment;
3. illuminating the origins of individuals and families;
4. using genomics to improve plant and animal breeding practices by seeing which have more productive genes;
5. discovering the causes of rare disorders and diseases;
6. choosing the right medication at the right dosage for each patient since the genome determines how the body responds to certain medications;
7. the ability to test unborn babies for genomic variants without invasive procedures for pregnant mothers; and
8. the possibility of editing the human genome and cure genetic diseases.

Figure 30: Projected size of the DNA next generation sequencing market worldwide, 2016-2025 (US$bn)
Source: Statista



The DNA sequencing market worldwide is forecast to grow at a tremendous pace by the middle of the upcoming decade, likely due to its ever-decreasing cost. According to the FT, in 2016 the cost of accurately sequencing all 3bn "letters" of a single person's DNA fell below the US$1,000 mark. In 2020, the MIT Technology Review wrote about China's "gene giant" group, BGI, which claimed it could break the $100 barrier.

The current genomics market

Illumina

According to its website, Illumina is a leading developer, manufacturer, and marketer of life science tools and integrated systems for the large-scale analysis of genetic variation and function. These systems are enabling studies that were not even imaginable just a few years ago and are moving them closer to the realisation of personalised medicine. The company is headquartered in San Diego, California, and employs 7,800 people globally. Its 2020 revenue reached US$3,236mn.

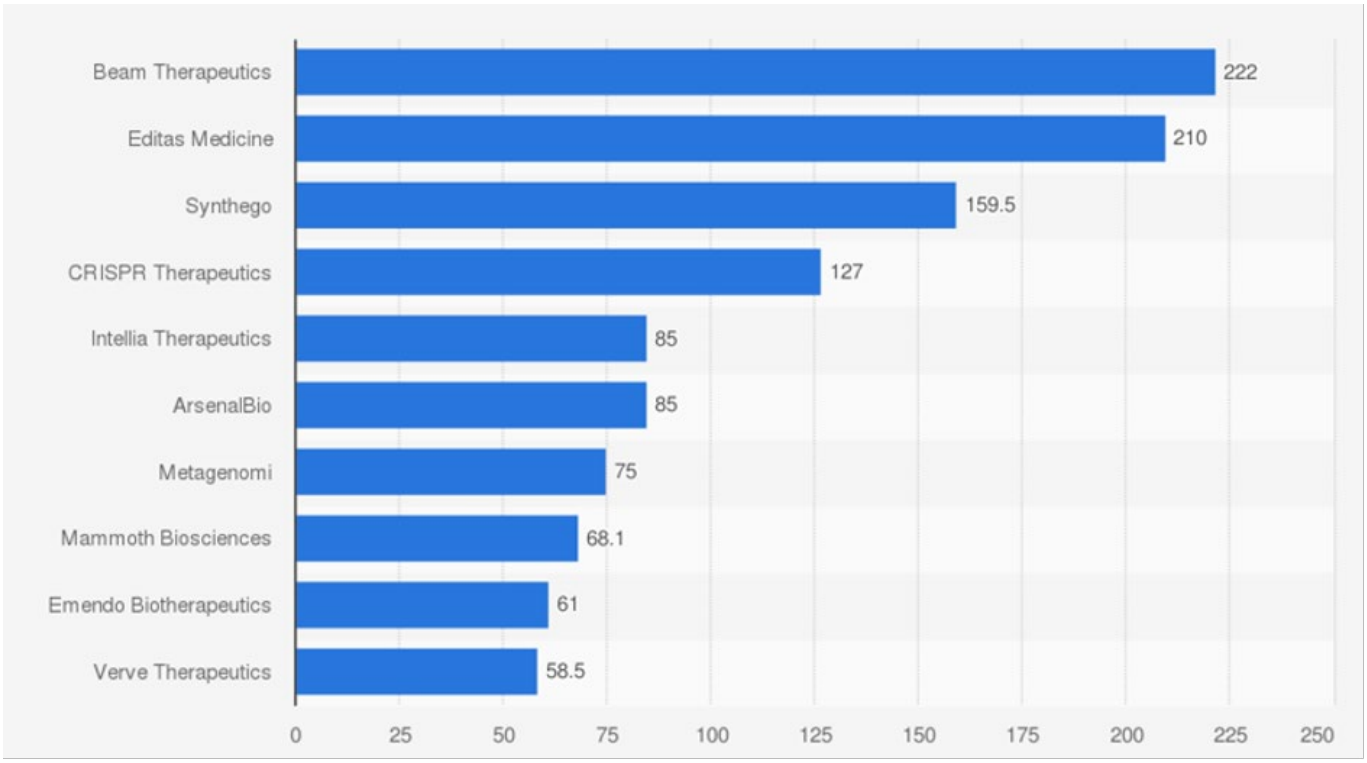
CRISPR-Cas9

CRISPR-Cas9 is a technique that allows for the highly specific and rapid modification of DNA in a genome, the complete set of genetic instructions in an organism. In theory, CRISPR technology could allow doctors to edit any genetic mutation at will, which would enable humans to cure any disease with a genetic origin. Some of the diseases that this technology has the potential to cure include:

- Cancer
- Blood disorders
- Blindness
- AIDS
- Cystic fibrosis
- Muscular dystrophy
- Huntington's disease
- COVID-19

There are many companies that have taken up the usage of CRISPR technology (see *Figure 37*)

Figure 31: Leading CRISPR startups worldwide as of April 2021 by funding (US$mn)
Source: Statista



Investment thesis: why invest in genomics?

1. It is a technology that could change the world and the medical sphere.
2. CRISPR is predicted to reach a market size of US$4,217mn by 2024.
3. DNA sequencing could be valued at US$22.7bn by 2025.

Points of concern: what might make investing risky?

1. It is a complicated field, and very few people understand it.
2. It is difficult to monetise.
3. It is still in the pre-revenue stage.

What do the Anchor experts say?

David Gibb

This is a massive growth area, with the potential to be as big as renewables and EVs. As mentioned in the book *The Code Breaker* by *Walter Isaacson*, the first 50 years of the last century was focused on the atom. The second 50 years were about the bit, which resulted in transistors and semiconductors that allowed for the technological revolution. Perhaps the next 50 years will be all about the gene.

Now that we understand the genome of all the organisms on the planet, do we edit them? One of the biggest discoveries is the CRISPR-CAS9 system, which is where scientists know how bacteria defends themselves from viruses. This process allows genome editing, which means we can cure genetic diseases. You essentially cut out the bad gene or you can add a gene using this system. This is an enormous industry with no revenues at present. It is early-stage and mostly pre-revenue. We have invested in Intellia, which is up enormously - we bought it at US$11.70/share and it is now up to over US$100/share in 15 months. We are looking for other ones.

Ross McConnochie

I agree that genomics is going to be revolutionary for the world but, again, as an investment thesis it is so difficult to pick which firm will be the most successful company in the industry. A quick Google search of companies using CRISPR will tell you how much this is already exploding. I like to invest in these types of businesses using exchange traded funds (ETFs) and not through company specific picks. It is again just too early to tell which companies will have the dominant technique in say ten years from now. Perhaps some analysts, with very strong scientific backgrounds, can make better predictions but I of course do not have that expertise so I cannot reasonably make a call on a specific company. So, investing in an ETF, to me, is the smarter play.

Nick Dennis

I had invested in Illumina which manufactures gene-sequencing equipment. Its growth really slowed down, and I do not know how much of that earlier growth was driven by the consumer side of gene sequencing. A lot of it is very interesting but what do you do with it? For a generalist like me it is so complex, and it takes a lot of time to understand.

I like to do a lot of deep research, and my portfolio is quite concentrated so I cannot have big positions in things I do not understand. If you do not understand the business, it is difficult to choose between competitors and products. As a field, this is extremely interesting and there are definitely opportunities if you are prepared to put in the time to research it. Perhaps in the next few years I will be comfortable enough to take a position but definitely not yet.

Liam Hechter

This can completely change everything about the world. Around the time that COVID-19 hit in 2020, there was a doctor in China, who was able to operate on a baby and use the CRISPR technology to extract the gene that could lead to AIDS. They have used this technology already.

The complexity comes in with the regulation. The government will have to regulate it very tightly. It is also probably difficult to monetise. Can something this powerful be in the hands of a corporate? And, when do you stop? Who creates the framework of, for example, who is allowed to operate on a baby inside a womb to remove a gene? The execution from the technology to revenue is difficult. Most businesses are pre-revenue at this stage. We are not near transforming this into a business or investment case yet.

Conclusion

It is clear from our deep dive into these trends that the world is changing. If it is not our transportation it is our medicine, and that is what makes these fields so incredibly exciting. Timing is everything, and from our experts we can see that some industries are still in their early stages whilst it might be too late for others.

These trends will nevertheless be the defining factors for the decade to come. **What humans will do with them, we will have to wait and see.**

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